

**SECTION 300. SUBGRADES, SUBBASES AND BASE COURSES****SUBGRADE****SECTION 301. SUBGRADE PREPARATION**

**301.01 Description.** This work shall consist of preparing the completed subgrade. It shall include shaping and final compaction of the earth for the construction of subbase, base, and surface courses.

**301.02 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Tandem Roller .....	1101.01
(b) Three-Wheel Roller.....	1101.01
(c) Tamping Roller .....	1101.01
(d) Pneumatic-Tired Roller .....	1101.01
(e) Subgrade Planer.....	1103.08
(f) Subgrade Machine.....	1103.09
(g) Heavy Subgrade Template .....	1103.10

**CONSTRUCTION REQUIREMENTS**

**301.03 General.** If the rough grading has been included in a previous contract, the roadbed shall be restored by removing all vegetation, filling all depressions, and smoothing the surface. If the contract includes rough grading and surfacing, the rough grading shall be completed as far in advance of the construction of the surfacing as feasible. Soft and unstable material that will not compact when rolled or tamped shall be removed and disposed of according to Article 202.03, and replaced with material approved by the Engineer, according to Articles 205.04 and 205.05.

The entire subgrade shall be compacted to not less than 95 percent of the standard laboratory density. Densities will be determined as provided in Article 205.05. All holes, ruts, soft places and other defects shall be corrected. In no case shall the surface course, base course, gutter, curb, or combination curb and gutter be placed on soft or unstable material, or over areas that are not drained in a manner satisfactory to the Engineer. If the subgrade is dusty or muddy, operations shall be delayed until it is in a condition satisfactory to the Engineer.

In cut sections, the Contractor responsible for the rough grading shall take the following steps in an effort to obtain not less than 95 percent of the standard laboratory density in the subgrade.

- (a) Step 1. Cut plan ditches which drain the area at least to grade. This shall be done at least two weeks prior to Step 2.

- (b) Step 2. Air dry the top 200 mm (8 in.) of subgrade. This procedure shall include at least two 200 mm (8 in.) depth processings utilizing discs or tillers each day for three consecutive good drying days.
- (c) Step 3. Recompect the layer processed in Step 2 to achieve not less than 95 percent density, or until at least nine passes of a roller which has demonstrated ability to obtain the density on adjacent earth work have been made.

When the work listed in the steps above has been accomplished and a subgrade in compliance with the Department's "Subgrade Stability Manual" has not been attained, the Engineer will make a determination as to whether additional drying and recompaction will be needed to obtain the stable subgrade or whether the ground and soil conditions warrant more extensive treatments. Extra work required after the steps listed above to obtain a satisfactory subgrade will be paid for according to Article 109.04.

The subgrade shall be constructed so that after being compacted, it will conform to the alignment, grade, and cross section shown on the plans, and as required by the Engineer. Surplus excavated material resulting from grading and shaping the subgrade shall be disposed of as directed by the Engineer. If additional material is required, it shall be obtained from the right of way if possible and approved by the Engineer. Placement shall be according to Articles 205.04 and 205.05.

Where rolling of the subgrade is required, any areas, which are inaccessible to a roller, shall be compacted by either a mechanical or hand tamper meeting the approval of the Engineer.

Equipment of such weight, or used in such a way as to cause a rut in the finished subgrade of 50 mm (2 in.) or more in depth, shall be removed from the work, or the rutting otherwise prevented.

**301.04 Aggregate Base Course and Aggregate Surface Course, Type A.**

The subgrade shall be compacted by rolling with the three-wheel, tandem, or pneumatic-tired roller. The rolling shall extend at least 300 mm (12 in.) beyond each edge of the proposed base course, unless otherwise required by the Engineer. No base course, gutter, curb, or combination curb and gutter shall be placed until the subgrade has been approved by the Engineer.

**301.05 Aggregate Surface Course, Type B.** The subgrade will not have to be rolled prior to placement of the aggregate surface course, Type 8. No surface course, gutter, curb, or combination curb and gutter shall be placed until the subgrade has been approved by the Engineer.

**301.06 Bituminous Concrete Base Course and Pavement (Full-Depth) and Portland Cement Concrete Base Course and Pavement.** The work shall be extended to at least 450 mm (18 in.) beyond each edge of the proposed base course or pavement. When a subbase is being placed under the base course or pavement, the work shall be extended to include the area being covered by the subbase material.

Prior to final shaping, the subgrade shall be compacted with a pneumatic-tired, three-wheel or tandem roller. Three-wheel or tandem rollers shall weigh from 5.5 metric tons (6 ton) to 9 metric tons (10 ton) and shall weigh not less than 35 N/mm (200 lb/in.) nor more than 57 N/mm (325 lb/in.) of width of the roller.

The subgrade shall be brought to true shape by means of a subgrade planer and/or subgrade machine according to the following:

- (a) Either the subgrade planer or the subgrade machine shall be used when:
  - (1) Portland cement concrete pavement or base course is constructed on the subgrade or subbase using forms.
  - (2) Bituminous base course is constructed.
- (b) The subgrade machine shall be used when :
  - (1) Portland cement concrete pavement or base course is constructed on the subgrade or subbase using the slip form method.
  - (2) Continuously reinforced portland cement concrete pavement is constructed on the subbase or subgrade.
  - (3) Bituminous concrete pavement (full-depth) is constructed.

The subgrade shall be tested for crown and elevation by means of a heavy subgrade template. High and low areas shall be brought to the correct elevation. After the subgrade has been corrected, it shall be rechecked.

When portland cement concrete is being placed directly on the subgrade, the subgrade shall be moist, but not muddy, at the time of placing the concrete. If required by the Engineer, the prepared subgrade shall be saturated with water the previous night, or not less than six nor more than 20 hours prior to the placing of the concrete. If the subgrade subsequently becomes too dry, it shall be sprinkled again ahead of placing the concrete, in such a manner as not to form mud or puddles of water.

The Contractor shall have at all times a minimum of one day's production of subgrade prepared ahead of the location at which the concrete is being placed.

The subgrade will be checked and approved by the Engineer before construction of the subbase, base course or pavement is started on any portion of the work. The Engineer may stop construction work at any time the subgrade is not in proper condition for the placing of the subbase, base course or pavement, or if the required amount has not been prepared ahead.

**301.07 Gutters, Curbs, and Combination Curb and Gutter.** The subgrade shall be compacted and finished to a firm, smooth surface in a manner approved by the Engineer.

**301.08 Drainage.** The subgrade shall be kept drained during the placing and compacting of the surface, base course, or subbase. If berms of earth are deposited

along the area upon which the subbase, base, or surface course is being placed, provision shall be made for surface drainage by cutting lateral ditches through the berms of earth.

**301.09 Maintenance.** The finished subgrade shall be maintained in a smooth and compacted condition until the subbase, base course, surface course, gutter, curb, or combination curb and gutter is placed.

**301.10 Method of Measurement.** When the contract includes both grading and paving, subgrade preparation will not be measured for payment.

- (a) **Contract Quantities.** The requirement for use of contract quantities shall be according to Article 202.07(a).
- (b) **Measured Quantities.** When the contract includes paving on a pregraded section, subgrade preparation will be measured for payment in units of 30 m (100 ft) in horizontal distances along baselines. No allowance will be made for variable width roadways.

**301.11 Basis of Payment.** When the contract includes grading and paving, subgrade preparation will not be paid for separately but shall be considered as included in the cost of to the various types of surface course, base course, subbase, gutter, curb, or combination curb and gutter included in the contract.

When the contract includes paving on a pregraded section, subgrade preparation will be paid for at the contract unit price per unit for SHAPING AND GRADING ROADWAY, which price shall include the excavation for removal or placement of all material within 50 mm (2 in.) of the grade and cross section shown on the plans or established by the Engineer. Excavation for the removal or placement of material outside this 50 mm (2 in.) tolerance will be paid for according to Article 109.04.

**SECTION 302. LIME MODIFIED SOILS**

**302.01 Description.** This work shall consist of the construction of a lime modified soil layer composed of soil, lime and water.

**302.02 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 Materials:

Item	Article/Section
(a) Water .....	1002
(b) Hydrated Lime .....	1012.01
(c) By-Product Lime for Lime Modified Soils .....	1012.03

**302.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Rollers (Note 1) .....	1101.01
(b) Distributor (Note 2)	
(c) Rotary Speed Mixer .....	1101.06
(d) Disk Harrow .....	1101.02
(e) Subgrade Planer .....	1103.08
(f) Subgrade Machine .....	1103.09
(g) Heavy Subgrade Template .....	1103.10

Note 1. Three-wheel rollers and tandem rollers, when used, shall weigh not less than 5.5 metric tons (6 ton) nor more than 11 metric tons (12 ton) and shall have a compression on the drive wheels of not less than 33 N/mm (190 lb/in.) nor more than 70 N/mm (400 lb/in.) width of roller.

Note 2. Distributor for spreading lime shall be cyclone, screw-type or pressure manifold type as approved by the Engineer.

## CONSTRUCTION REQUIREMENTS

**302.04 General** Lime shall not be applied to or mixed with frozen soil. The amount of lime modified soil constructed shall be limited to that which can be covered with subbase, base or pavement within the same construction season, unless otherwise permitted by the Engineer.

### 302.05 Proportioning.

- (a) Samples. The Contractor, at his/her own expense, shall provide a minimum of 5 kg (10 lb) of lime and 45 kg (100 lb) of soil proposed to be used at least 30 days prior to the construction of the lime modified soils.
- (b) Mix Design. Lime will be proportioned within a range of two - six percent of soil (oven dry basis). The required proportion of lime will be established by the Engineer prior to construction, using samples of the proposed soil and lime, and the Department's Geotechnical Manual procedure for lime modified soil available on request. The Engineer reserves the right to make such adjustments of lime proportioning as are considered necessary during the progress of the work within the range specified, without additional compensation to the Contractor.

Source or type of lime shall not be changed during the progress of the work without permission of the Engineer.

**302.06 Spreading of Lime.** The surface of the grade shall be lightly scarified or disked prior to distribution of the lime. The lime shall then be distributed uniformly over the surface. The Engineer may reject any procedure which does not provide even distribution of lime.

Lime shall not be applied when wind conditions are such that blowing lime becomes objectionable to adjacent property owners or creates a hazard to traffic on adjacent highways.

The spreading of lime shall be limited to that amount which can be incorporated into the soil within the same working day. In the event that rain intervenes causing cessation of work and exposure of the lime to washing or blowing, the Engineer may require additional lime to be spread at no cost to the Department.

**302.07 Mixing.** The lime, soil, and water (if necessary) shall be thoroughly blended by rotary speed mixers or a disk harrow. The mixing shall continue until it has been determined by the Engineer that a homogeneous layer of the required thickness has been obtained. The loose thickness of a single lime modified layer shall not exceed 200 mm (8 in.) if a disk harrow is used, or 350 mm (14 in.) if a rotary speed mixer is used.

**302.08 Compaction.** Compaction of the mixture shall begin as soon as is practicable after mixing. In no case shall compaction be started later than three days after mixing unless approved by the Engineer. If compaction is to be delayed, the surface of the lime modified soil shall be crown-graded and sealed by either blade dragging or light rolling immediately after mixing.

Compaction shall be continued until the lime modified layer has a density of not than 95 percent of the standard dry density. The standard dry density of the lime treated soil shall be determined from AASHTO T 99 (Method C). The field in place dry density will be determined by the Engineer according to AASHTO T 191 or Illinois Modified AASHTO T 310 (Direct Transmission Density/Backscatter Moisture), or by other methods approved by the Engineer.

Aeration by means of further mixing, or the addition of water and further mixing may be required by the Engineer to achieve the required compaction.

**302.09 Finishing.** The final lift of lime modification shall be constructed approximately to the grade shown on the plans before spreading the lime. The final lift of lime modification shall be no less than 150 mm (6 in.) thick when compacted. When compaction of the final lift of lime modified soil is nearing completion, the surface shall be shaped to the required lines, grades and cross section, and compaction shall be continued until uniform and adequate density is obtained.

For bituminous concrete base course and pavement (full-depth) and portland cement concrete base course and pavement construction, the surface of the lime modified soil shall be brought to true shape and correct elevation according to Article 301.06, except that well compacted earth shall not be used to fill low areas.

**302.10 Method of Measurement.**

- (a) Contract Quantities. The requirements for the use of contract quantities shall conform to Article 202.07(a).

- (b) **Measured Quantities.** Processing lime modified soils will be measured in place and the area computed in square meters (square yard). The width for measurement will be as shown on the plans.

Water used will be measured in units of 1000 L (1000 gal). A weigh ticket or meter ticket for each truck load shall be furnished to the Engineer. Scales or meters shall be approved by the Engineer.

Lime will be measured for payment in metric tons (ton). The lime shall be measured in trucks or freight cars. The Contractor shall furnish or arrange for use of scales of a type approved by the Engineer. If the lime is shipped

in trucks, it shall be measured at the place of loading, at the place of unloading, or at such other place as the Engineer may designate. The Engineer may accept original signed freight bills in lieu of determining the mass (weight).

Should the Contractor's method of construction require extra earth excavation or embankment due to requiring more than one lift to construct the lime modified soil layer as shown on the plans, this extra earth excavation and embankment will not be measured for payment.

**302.11 Basis of Payment.** This work will be paid for at the contract unit price per square meter (square yard) for PROCESSING LIME MODIFIED SOILS of the thickness specified, per unit for WATER, and per metric ton (ton) for LIME.

## SUBBASE

### SECTION 310. LIME STABILIZED SOIL MIXTURE

**310.01 Description.** This work shall consist of the construction of a lime stabilized soil mixture, composed of "reactive soil", lime and water which shall be considered as subbase.

**310.02 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 - Materials:

Item	Article/Section
(a) Water .....	1002.01 - 1002.02
(b) Hydrated Lime (Note 1) .....	1012.01
(c) Non-Hydrated By-Product Lime for Lime Stabilized Soil Mixture .....	1012.04
(d) Soil (Note 2)	

Note 1. Quick lime, meeting the requirements for calcium lime stated in ASTM C 5, may be substituted if used in a slurry.

Note 2. The soil shall be a "reactive soil". "Reactive soils" are defined as those soils which when mixed thoroughly with at least three percent lime, compacted and cured for 48 hours at 49 °C (120 °F) will exhibit a

compressive strength gain of at least 345 kPa (50 psi) greater than that obtained from similarly prepared untreated control specimens. The compressive strength shall be according to AASHTO T 208.

**310.03 Equipment.** Equipment shall meet the requirements of Article 302.03, except that three-wheel rollers and tandem rollers shall weigh not less than 5.5 metric tons (6 ton) nor more than 11 metric tons (12 ton) and shall have a compression on the drive wheels of not less than 33 N/mm (190 lb/in.) nor more than 70 N/mm (400 lb/in.) width of roller.

## CONSTRUCTION REQUIREMENTS

**310.04 General.** The lime stabilized soil mixture shall be constructed between April 15 and September 15, and placed only when the temperature of the subgrade measured 50 mm (2 in.) to 75 mm (3 in.) below the surface, is above 10 °C (50 °F), and the air temperature in the shade is above 4 °C (40 °F). In no instance shall lime be applied to or mixed with frozen soil. The amount of subbase course constructed shall be limited to that which can be covered by the succeeding pavement layer during the same construction season. If any of these conditions are not met, the Contractor shall remove and replace the affected portion of the work at his/her own expense.

**310.05 Proportioning.** The actual proportions of lime, soil and water will be determined according to the Department's Geotechnical Manual procedure (available on request) by the Engineer before work begins, utilizing the project soil(s) and the lime intended for use. The right is reserved by the Engineer to make such changes in proportions during the progress of the work as becomes necessary. In no case shall proportions or type of lime be changed during the progress of the work without written permission.

- (a) **Samples.** The Contractor shall, at his/her own expense, submit to the Engineer a minimum of 11 kg (25 lb) of lime and 90 kg (200 lb) of subgrade soil which the Contractor proposes for use in the mixture. The lime, when sampled, shall be placed immediately in a sealed container and shall be kept sealed. Samples shall be delivered at least 45 days prior to the construction of the lime stabilized soil mixture. The samples, as submitted, will be tested for acceptance of the materials and used to determine preliminary proportions for the mixture composition.
- (b) **Design.** The lime and soil shall be proportioned within the limits of from three to eight percent lime based on the dry weight of the soil. The mixture used shall provide a minimum laboratory average compressive strength of 690 kPa (100 psi), according to AASHTO T 208.

**310.06 Preparation of Subgrade.** If the roadway has been graded under a separate contract or is being graded under this contract, the area to be processed shall be shaped to the proper grade and cross section. All vegetation and other objectionable material shall be removed from within the limits of lime treatment.



**310.07 Scarification and Pulverization.** If necessary, the soil to be processed shall be scarified or pulverized to the required treatment depth prior to the application of the lime. Precautions shall be taken to avoid forming furrows of loosened material below the depth specified for the lime stabilized soil mixture.

**310.08 Lime Application.** Lime (slurry or dry) shall be spread on that area where the initial mixing operations can be completed during the same working day. The surface of the grade shall be lightly scarified or disked prior to distribution of the lime (slurry or dry). The application of lime shall be accomplished by the methods hereinafter described as "Slurry Placing" or "Dry Placing".

Lime (slurry or dry) that has been exposed to the open air for a period of six hours or more shall be replaced by the Contractor at his/her expense.

(a) **Slurry Placing.** Slurry Placing shall be restricted to either hydrated Type N or Quicklime, and it shall be prepared and transported to the roadbed by one of the following methods:

(1) **Central Plant.** Agitation shall be accomplished through integral paddles, recirculating pumps, compressed air, or a combination of these devices. The slurry distributor truck, hauling from the central plant, shall be equipped with a recirculating pump or agitator of sufficient size to keep the lime and water in a uniform mixture until spread.

The slurry produced shall consist of a minimum mixture of approximately 1 metric ton (1 ton) of lime to each 2000 L (500 gal) of water (about 31 percent solution) and shall not contain more than 40 percent lime (by weight). It shall be placed within 24 hours after mixing.

(2) **Jet Mixer.** The portable jet slurry plant shall be capable of producing slurry instantaneously by jetting water approximately 500 kPa (75 psi) and lime continuously in a 65:35 (by weight) ratio into a mixing bowl. This type of portable slurry plant generally eliminates the need for batching tanks. The distributor shall be equipped to keep the slurry agitated and in a uniform mixture if it cannot be spread on the embankment within 20 minutes of its preparation.

(3) **Portable Batch Slaker.** Slurry from the quicklime shall be prepared in an approved portable batch slaker. Quicklime, when coming into contact with a perspiring worker's skin, can cause burns; therefore, workers shall be suitably protected. Uniformity of the slurry shall be attained in each batch by adding the required amount of water, then the quicklime, and then agitating. The slurry produced shall not contain more than 40 percent lime (by weight). The distributor shall be equipped to keep the slurry agitated and in a uniform mixture if it cannot be spread on the embankment within 20 minutes of its preparation.

The lime slurry shall be distributed uniformly on the roadbed by gravity or pressure spray bars. The number of passes to apply the required amount of lime shall be approved by the Engineer.

- (b) Dry Placing. Dry placing shall be restricted to either hydrated Type N or non-hydrated by-product lime. The lime (except quicklime) shall be spread uniformly by means of cyclone, screw, or pressure manifold type distributors at the rates directed by the Engineer.

The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by wind to a minimum and dry lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to traffic and adjacent property owners.

**310.09 Mixing.** Prior to final compaction, lime stabilized mixture shall be pulverized to meet the gradation requirements as given below under Article 310.09(b). To meet this requirement, two-stage mixing shall be required for heavy clay soils. One-stage mixing may be permitted by the Engineer, provided that the requirements for final mixing are met. The required mixing procedure shall be as follows:

- (a) Initial Mixing. The lime, soil, and water shall be thoroughly mixed and blended by approved equipment until a uniform mixture throughout the required depth and width is obtained. All clods and lumps shall be reduced to a maximum of 50 mm (2 in.) diameter size. Water shall be added during the initial mixing operation in a sufficient quantity to bring the moisture content to at least three percentage points above optimum. When proper mixing has been accomplished, light rolling to seal the surface of the mixture shall be performed to minimize evaporation loss, lime carbonation, or to prevent wetting from heavy rains, and the mixture shall be left to undergo a conditioning period of at least 48 hours or as directed by the Engineer. The mixture shall be maintained in a moist condition throughout the entire conditioning period.
- (b) Final Mixing. After the required conditioning period, the mixture shall be uniformly mixed by approved methods and maintained at approximately optimum moisture content as determined herein. If the lime stabilized soil mixture contains clods, they shall be reduced by pulverization so that the lime treated soil will meet the following requirements:

Minimum passing 25 mm (1in.) sieve .....	100%
Minimum passing 4.75 mm (No. 4) sieve .....	60%

**310.10 Compaction.** Compaction of the mixture shall begin immediately after the final mixing or at a time when the final mixing pulverization requirements are met. Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth and width. The mixture shall then be uniformly compacted until the specified density has been obtained. Particular care shall be exercised to insure density along the edges of the section and adjacent to construction joints.

The compaction shall be continued until a dry density of not less than 95 percent of the standard laboratory density of the lime stabilized mixture as determined by AASHTO T 99 (Method C) has been achieved. Any portion of the lime stabilized soil mixture that has a dry density of less than 95 percent of the standard dry density shall be corrected or removed and replaced to meet this specification at the Contractor's expense. The in-place dry density shall be determined by the Engineer according to

AASHTO T 191 or Illinois Modified AASHTO T 310 (Direct Transmission Density/Backscatter Moisture), or by other methods approved by the Engineer.

**310.11 Finishing and Curing.** When initial compaction of the top layer of the lime stabilized soil mixture is nearing completion, the surface shall be shaped to the required lines, grades, and cross section, and compaction continued until uniform and adequate compaction is obtained. For bituminous concrete base course and pavement (full-depth) and portland cement concrete pavement and base course, the surface of the lime stabilized soil mixture shall be brought to true shape and correct elevation according to Article 301.06 except that well compacted earth shall not be used to fill low areas. The surface shall be maintained in a moist condition by means of a fine spray during all finishing operations. The lime treated soil shall be cured for a period of seven days and maintained at a moisture content satisfactory for proper curing by sprinkling, or application of liquid bituminous material. During this period, no traffic shall be permitted on the completed work beyond that required for maintenance of curing moisture, or application of bituminous curing material.

The bituminous material used for curing shall be Emulsified Asphalt RS-1, RS-2, CRS-1, CRS-2, Liquid Asphalt RC-70, RC-250, MC-70, MC-250, and shall be applied at the rate of approximately 1 L/sq m (0.20 gal/sq yd) and shall be applied uniformly to the surface of the subbase by a pressure distributor to give complete coverage without excessive runoff. The exact rate of application and temperature will be specified by the Engineer. At the time this bituminous material is applied, the surface shall be tightly knit, free of all loose or extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material.

**310.12 Construction Joints.** Construction joints will not be required between each day's work unless there is a time lapse of seven days or more between the processing of adjacent sections. If construction joints are required, they shall be formed by cutting back 1 m (3 ft) into the completed work to form a vertical face. Otherwise, damage to completed work shall be avoided.

**310.13 Maintenance.** The Contractor shall maintain, at his/her own expense, entire lime stabilized soil mixture in a manner satisfactory to the Engineer.

Maintenance shall include immediate repairs of any defective or damaged portions of the mixture.

**310.14 Method of Measurement.** This work will be measured for payment according to the following methods:

- (a) Processing lime stabilized soil mixture will be measured for payment in place and the area computed in square meters (square yards) of lime stabilized soil mixture completed and accepted. The width of measurement will be the width from outside-to-outside of the completed lime stabilized soil mixture as shown on the plans or as determined by the Engineer.
- (b) Water used for slurry, compacting, finishing and curing will be measured for payment in units of 1000 L (1000 gal), as specified in Article 302.10.
- (c) Lime incorporated in the lime stabilized soil mixture shall be measured for payment in metric tons (tons) as specified in Article 302.10, but payment will

not be made for lime in excess of 105 percent of the amount specified by the Engineer.

- (d) Bituminous materials will be measured for payment as specified in Section 1009.

**310.15 Basis of Payment.** This work will be paid for at the contract unit price per square meter (square yard) for PROCESSING LIME STABILIZED SOIL MIXTURE, of the thickness specified; per metric ton (ton) for LIME; per liter (gallon) for BITUMINOUS MATERIALS; and per unit for WATER.

**SECTION 311. GRANULAR SUBBASE**

**311.01 Description.** This work shall consist of furnishing, placing and compacting granular material on the prepared subgrade.

**311.02 Materials.** Materials shall meet the requirements of the following Article of Section 1000 - Materials:

Item	Article/Section
(a) Subbase Granular Material .....	1004.04

**311.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Three-Wheel Roller .....	1101.01
(b) Tandem Roller .....	1101.01
(c) Pneumatic-Tired Roller .....	1101.01
(d) Vibratory Machine (Note 1)	
(e) Subgrade Planer .....	1103.08
(f) Subgrade Machine .....	1103.09
(g) Heavy Subgrade Template .....	1103.10

Note 1. The vibratory machine shall meet the approval of the Engineer.

**CONSTRUCTION REQUIREMENTS**

**311.04 Subgrade.** The subgrade shall be prepared according to Section 301 except Articles 301.04 and 301.05 will not apply.

**311.05 Placing and Compacting Subbase Materials.** Granular material used for subbase shall be placed to the widths and thickness' shown on the plans and as follows:

- (a) General. The granular material shall be placed and compacted as specified for the particular type of granular subbase. If any earth is worked into the granular material during the compacting or finishing operations, all granular material within the affected area shall be removed and replaced with new granular material. The Engineer may restrict hauling over the completed or

partially completed work after inclement weather or at any time when the earth subgrade is soft and there is a tendency for the earth to work into the granular material.

The granular material shall be placed and compacted at least three days prior to the placement of pavement or base course.

If the moisture content is insufficient to maintain satisfactory compaction or to prevent segregation or raveling when hauling is permitted over the granular material, water shall be added as directed by the Engineer.

When construction of the granular subbase has been completed at a location, or when directed by the Engineer, the Contractor shall salvage the excess granular material outside the construction limits of the granular subbase. The salvaged granular material shall be carried forward and utilized in the construction of the granular subbase. The Contractor shall salvage the granular material in such a manner as to prevent segregation and the incorporation of earth.

- (b) Subbase Granular Material, Type A. The granular material shall be uniform in gradation. Before the material is deposited on the roadway, it shall contain the amount of moisture required for compaction. The amount of moisture required shall be that determined by the Engineer for the material and the compaction methods being used. The water and granular material shall be mixed at a central mixing plant equipped with a mechanical mixing device and granular material and water measuring devices meeting the approval of the Engineer. Wetting the aggregate by jetting in cars, bins, stockpiles or trucks will not be permitted. Moisture shall be added to the material during compaction only when it is necessary to increase the percentage of moisture to obtain satisfactory compaction.

The subbase shall be constructed in layers not more than 100 mm (4 in.) thick when compacted, except that if tests indicate that the desired results are being obtained, the compacted thickness of any layer may be increased to a maximum of 200 mm (8 in.).

The granular material shall be deposited full-lane width with a mechanical spreader or spreader box of a type approved by the Engineer, in a manner that shall not cause segregation and that shall require minimum blading or manipulation. The equipment and the method used shall be approved by the Engineer.

Each layer shall be compacted immediately after placing. The granular material shall be compacted to not less than 95 percent of the standard laboratory density.

The standard laboratory density shall be the maximum dry density determined according to AASHTO T 99 (Method C). A coarse particle correction according to AASHTO T 224 shall be used.

The dry density of the compacted subbase will be determined by the Engineer at regular intervals according to AASHTO T 191 or Illinois Modified

AASHTO T 310 (Direct Transmission Density/Backscatter Moisture), or by other methods approved by the Engineer.

- (c) Subbase Granular Material, Type B. The subbase shall be constructed in layers not more than 150 mm (6 in.) thick when compacted, except that if tests indicate that the desired results are being obtained, the compacted thickness of any layer may be increased to a maximum of 200 mm (8 in.). Each layer of material shall be compacted in a manner approved by the Engineer. If the moisture content of the material is such that compaction satisfactory to the Engineer cannot be obtained, sufficient water shall be added, at the Contractor's expense, so that satisfactory compaction can be obtained.
- (d) Subbase Granular Material, Type C. The subbase shall be compacted to the satisfaction of the Engineer. The manner of placing and compacting the material shall be approved by the Engineer prior to starting this work.

**311.06 Finishing of Subbase for Portland Cement Concrete Base Course and Pavement.** The subbase shall be brought to true shape according to Article 301.06 except for the following.

The compacted subbase shall be placed above the plan elevation and the excess trimmed or cut with the subgrade machine. The Contractor shall determine the amount of excess subbase material necessary to meet this requirement. After the subbase has been brought to its true shape and correct elevation, the surface shall be wetted and rolled as directed by the Engineer with a three-wheel or tandem roller meeting the weight requirements specified in Article 301.06. The surface of the subbase shall be tested for crown and elevation by means of a template.

The Contractor shall have at all times a minimum of one day's production of subbase prepared ahead of the paving.

The subbase shall be moist at the time of placing the concrete. If required by the Engineer, the prepared subbase shall be saturated with water the previous night, or not less than six nor more than 20 hours prior to the placing of the concrete. If the subbase subsequently becomes too dry, it shall be sprinkled again ahead of placing the concrete, in such a manner as not to form puddles of water.

**311.07 Tolerance in Thickness.** The subbase shall be constructed to the thickness shown on the plans. Thickness determinations shall be made at such points as the Engineer may select. When the constructed thickness is less than 90 percent of the thickness shown on the plans, aggregate shall be added to obtain the specified thickness; however, the surface elevation of the completed subbase shall not exceed by more than 5 mm (3/16 in.) the surface elevation shown on the plans or authorized by the Engineer.

**311.08 Method of Measurement.**

- (a) Contract Quantities. The requirements for the use of contract quantities shall conform to Article 202.07(a).

- (b) Measured Quantities. Granular subbase will be measured for payment in metric tons (ton), cubic meters (cubic yard) or square meters (square yard) of the thickness specified. Water required to be added for compaction on the grade will not be measured for payment, but shall be considered as included in the cost of the item of work being constructed. When the unit of measurement for the aggregate is metric tons (ton), the aggregate may be weighed in trucks or freight cars. The Contractor shall furnish or arrange for the use of scales of a type approved by the Engineer. If, at the time the Type A aggregate is weighed, it contains more than six percent of absorbed and free moisture by weight, a deduction for the amount of moisture in excess of this amount will be made in determining the pay quantity. Any aggregate that has been stockpiled will be weighed at the time it is incorporated into the work.

If the material is shipped in trucks, it may be weighed at the place of loading, at the place of unloading, or at such other place as the Engineer may designate. If the material is shipped in freight cars, the Engineer will accept the freight car weights, instead of scale weights, provided the Engineer is satisfied that the car weights are sufficiently accurate. In order to verify the car weights, the Contractor will be required to weigh the contents of at least ten percent of the freight cars received each day, with a minimum of one car weight each day, over truck scales. If the truck weights do not verify the freight car weights, additional cars shall be weighed. In addition to this verification, the Contractor will be required to weigh the contents of any freight car that appears deficient in material. The Contractor shall furnish the original signed freight bill for each car.

When the unit of measurement for the aggregate is metric ton (ton), payment will not be made for aggregate in excess of 108 percent of the amount specified by the Engineer nor for aggregate placed outside the design width plus 150 mm (6 in.).

When the unit of measurement for the aggregate is cubic meter (cubic yard), the aggregate will be measured in place and the volume computed in cubic meters (cubic yard). The width and depth for measurement will be as shown on the plans.

When the unit of measurement for the aggregate is square meter (square yard), the aggregate will be measured in place and the area computed in square meters (square yard). The width for measurement will be as shown on the plans.

If the granular material removed during the subgrading operation is not carried forward and incorporated in the granular subbase, a deduction will be made for the quantity not salvaged, except that no deduction will be made where the quantity not salvaged is less than 5 cu m/100 m (2 cu yd/station) or where cubic meters (cubic yard) or square meters (square yard) is the basis of payment.

**311.09 Basis of Payment.** Subbase Granular Material, Type A, Subbase Granular Material, Type B, and Subbase Granular Material, Type C, will be paid for at the contract unit price per metric ton (ton) for SUBBASE GRANULAR MATERIAL, TYPE A, SUBBASE GRANULAR MATERIAL, TYPE B, or SUBBASE GRANULAR

MATERIAL, TYPE C, at the contract unit price per cubic meter (cubic yard) for SUBBASE GRANULAR MATERIAL, TYPE A, SUBBASE GRANULAR MATERIAL, TYPE B or SUBBASE GRANULAR MATERIAL, TYPE C; or at the contract unit price per square meter (square yard) of the thickness specified for SUBBASE GRANULAR MATERIAL, TYPE A, SUBBASE GRANULAR MATERIAL, TYPE B, or SUBBASE GRANULAR MATERIAL, TYPE C, which price shall include performing all of the work specified.

**SECTION 312. STABILIZED SUBBASE**

**312.01 Description.** This work shall consist of furnishing, placing and compacting a bituminous aggregate mixture, cement aggregate mixture, or pozzolanic stabilized mixture on the subgrade.

**312.02 General.** The Contractor shall have the option within the time limitations and weather condition requirements of selecting the type of stabilization, except no change in type will be permitted unless authorized by the Engineer. When time limitations or weather conditions require that construction of a particular type of stabilization be discontinued, the Contractor shall proceed without delay with the construction of an alternate type which is permissible under the requirements of this Section. The Contractor will receive no additional compensation by reason of such change.

The amount of stabilized subbase constructed will be limited to that which can be surfaced during the current construction service.

The Contractor shall have at all times one day's production of subbase prepared ahead of the paving location.

Prior to placing the stabilized mixture, the subgrade shall be prepared according to Section 301 except Articles 301.04 and 301.05 will not apply, or Section 302 when specified.

**BITUMINOUS AGGREGATE MIXTURE**

**312.03 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 - Materials:

Item	Article/Section
(a) Aggregate (Note 1) (Note 2) .....	1004.04
(b) RAP Material (Note 3) .....	1004.07
(c) Bituminous Materials (Note 4) .....	1009.01-1009.05, 1009.09

Note 1. When blending is approved, fine material will be permitted in the blend provided that the Fine Aggregate is Class C quality or higher and the Mineral Filler complies with the requirements of Article 1011.01. Blending proportions shall not be changed during the progress of the work without permission from the Engineer.



The gradation of the aggregate and/or the combined gradations of the aggregates shall conform to the required limits, except there shall not be less than three percent permitted to pass the 75  $\mu\text{m}$  (No. 200) sieve on an unwashed sample, as determined by the combined hot bin proportions.

Note 2. The Contractor may request approval to use the aggregate not meeting the requirements of Article 1004.04(c); if approval is granted, all other requirements of Article 1004.04 and of Note 1 above shall apply.

The request for approval shall be submitted at least four weeks prior to production and shall include a laboratory test report listing the proposed source(s) of materials, percent and gradation(s) of the aggregate(s), asphalt type and content, and combined mix gradation with test data showing that the mix proposed meets the following design criteria:

- a. Minimum stability of 3.3 kN (750 lb) when tested according to AASHTO T 245.
- b. Maximum air void content of six percent in specimens prepared according to AASHTO T 245 as determined by the Department's high air pressure meter method or according to AASHTO T 209.

Additional Testing may be required to determine the acceptability of the mix proposed. If the mix proposed appears to be acceptable, the Engineer will observe the Contractor's operation prior to granting approval to assure that sound quality control practices are being used in manufacturing the aggregate. Failure of the mix to perform satisfactorily will be sufficient cause for rejection.

Once a mix is approved, the aggregate or combined aggregates shall be kept within the following tolerances:

Passing 25.0 mm (1 in.) sieve .....	0% *
Passing 12.5 mm (1/2 in.) sieve .....	$\pm 20\%$
Passing 4.75 mm (No. 4) sieve.....	$\pm 10\%$
Passing 1.18 mm (No. 16) sieve.....	$\pm 15\%$
Passing 75 $\mu\text{m}$ (No. 200) sieve .....	4% **

\* All material shall pass the 250 mm (1 in.) sieve.

\*\* Maximum of 12% passing 75  $\mu\text{m}$  (No. 200) sieve.

Note 3. The original pavement or hot-mix bituminous materials need not contain crushed coarse aggregate.

Note 4. The bituminous material used in the mixture shall be asphalt cement Grade PG46-28, PG52-28, PG58-28, PG58-22 or liquid asphalt MC-3000, except when RAP materials or aggregates not meeting the requirements of Article 1004.04(c) (Note 2 above) are used, liquid asphalt MC-3000 will not be permitted.

The Engineer reserves the right to specify the grade which shall be used. The bituminous material shall not be changed during the progress of the work without permission of the Engineer.

**312.04 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Three-Wheel Roller (Note 1) .....	1101.01
(b) Tandem Roller (Note 1) .....	1101.01
(c) Self-Propelled Pneumatic-Tired Roller (Note 2) .....	1101.01
(d) Trench Roller (Note 3) .....	1101.01
(e) Hot-Mix Plant (Note 4) .....	1102.01
(f) Mechanical Spreader (Note 5) .....	1102.03
(g) Vibratory Roller .....	1101.01
(h) Subgrade Planer .....	1103.08
(i) Subgrade Machine .....	1103.09
(j) Heavy Subgrade Template .....	1103.10

Note 1. Three-wheel rollers and tandem rollers shall weigh not less than 5.5 metric tons (6 ton) nor more than 11 metric tons (12 ton), and shall have a compression on the drive wheels of not less than 33 N/mm (190 lb/in.) nor more than 70 N/mm (400 lb/in.) width of roller.

Note 2. The self-propelled pneumatic-tired roller shall develop a compression of not less than 53 N/mm (300 lb/in.) of width of tire tread in contact with the bituminous surface.

Note 3. Trench rollers shall be self-propelled and shall develop a compression of not less than 53 N/mm (300 lb/in.) nor more than 70 N/mm (400 lb/in.) of width on the compaction wheel.

Note 4. For bituminous aggregate mixture, a hot-mix plant conforming to Article 1102.01 will be required except that Article 1102.01 (a)(3), Article 1102.01 (b)(2), (6), (7), (8) and (9), and Article 1102.01 (c)(1) and (5) shall not apply. When the aggregates are blended, aggregate feeders for each size shall be provided according to Article 1102.01 (a)(3). If mineral filler is used, Article 1102.01 (b)(2) also shall apply. A metering system for the collected dust will not be required. When a drier drum hot-mix plant is used to produce a bituminous aggregate mixture incorporating RAP material, the plant shall be suitably modified to produce recycled bituminous mixes in a manner approved by the Engineer.

Note 5. The mechanical spreader shall be a spreading and finishing machine meeting the requirements of Article 1102.03 or it may be a type approved by the Engineer.

**CONSTRUCTION REQUIREMENTS**

**312.05 General.** The bituminous aggregate mixture shall be constructed only when the temperature in the shade is above 10 °C (50 °F) when liquid asphalt is used. No mixture shall be placed on a frozen or muddy roadbed.

**312.06 Composition.** The aggregate and bitumen shall be proportioned within the following composition limits by weight:

<u>Ingredient</u>	<u>Percent by Weight</u>
Aggregate .....	94.0 to 96.0
Residual Bitumen .....	4.0 to 6.0*

\*Upper limit may be raised for the lower or top lifts if the Contractor elects to use a highly absorptive coarse and/or fine aggregate requiring more than 6% asphalt. The additional asphalt shall be furnished at no cost to the Department.

When RAP materials are being used, the RAP material, virgin aggregate(s) and asphalt cement shall be proportioned within the following composition limits by weight:

<u>Ingredient</u>	<u>Percent by Weight</u>
Virgin Aggregate(s) .....	46 - 93
RAP Material(s) .....	0 - 50
Mineral Filler (if required) .....	0 - 5
Asphalt Cement.....	4.0 - 7.0

The percentage of residual bitumen shall be controlled within  $\pm 0.5$  percent of the percentage set by the Engineer. The right is reserved by the Engineer to make such changes in proportions during the progress of the work, as the Engineer may consider necessary.

**312.07 Preparation of Materials.** When asphalt cement is used, it shall be transferred to the asphalt tanks and heated to a temperature of 120 °C (250 °F) to 175 °C (350 °F). If the loading temperature exceeds 175 °C (350 °F), the asphalt shall not be used. When liquid asphalt is used, the bituminous material shall be heated to such a temperature that it will be workable when used. Wide variations in temperature, which affect the quantity of asphalt delivered, will not be permitted.

**312.08 Preparation of Mixture.** The aggregate shall be dried and heated in the revolving drier to a temperature of 120 °C to (250 °F) to 165 °C (325 °F), except when a drier drum hot-mix plant is used.

The aggregate and bituminous material used in the bituminous aggregate mixture shall be measured separately and accurately by weight or by volume. When the aggregate is in the mixer, the bituminous material shall be added and mixing continued for a minimum of 30 seconds and until a homogeneous mixture is produced in which all particles of the aggregate are coated. The mixing period, size of the batch or the production rate of continuous mixers shall be approved by the Engineer.

When liquid asphalt, MC-3000 is used, the foregoing requirements for the bituminous aggregate mixture using asphalt cement shall apply, except the ingredients for the bituminous aggregate mixture shall be heated and combined in such a manner and at such a temperature as to produce a mixture which when discharged from the pug mill shall be workable, but at no time shall the temperature of the mixture be more than 105 °C (225 °F), or the flash point of the bituminous

material. The aggregate shall be surface dry and shall contain not more than one percent of moisture by weight.

The ingredients shall be heated and combined in such a manner as to produce a bituminous mixture which when discharged from the mixer will, in general, not vary more than 10 °C (20 °F) from the temperature set by the Engineer. When using asphalt cement, the temperature of the mixture shall not be more than 165 °C (325 °F).

When RAP material(s) is used in the bituminous aggregate mixture, the virgin aggregate(s) shall be dried and heated in the drier to a temperature that will produce the specified resultant mix temperature when combined with the RAP material.

The heated virgin aggregates and mineral filler shall be combined with the RAP material in such a manner as to produce a bituminous mixture which when discharged from the mixer shall not vary more than 15 °C (30 °F) from the temperature set by the Engineer. The combined ingredients shall be mixed for a minimum of 30 seconds or until a homogeneous mixture as to composition and temperature is obtained. For a batch type plant, the standard 15 seconds dry and 30 seconds wet mixing time should normally be used. Variation in wet and dry mixing times may be permitted, depending on the moisture content and amount of salvaged material used. The mix temperature shall not exceed 175 °C (350 °F). Wide variations in the mixture temperature will be cause for rejection of the mix.

The final mixture(s) shall conform to the following Standard Deviations. These deviations will be verified by extraction tests of the final mixture. If these stipulations are not met, the amount of RAP material used shall be reduced by ten percent increments per day until mix is produced meeting these requirements. When the Contractor is able to produce mixtures within these criteria for three consecutive days, the percent of RAP material may again be increased.

Selected Criteria (CA-6)	Standard Deviation1/	Tolerance2/
Passing 25 mm (1 in.) sieve	5.0	90-100
Passing 12.5 mm (1/2 in.) sieve	6.5	60- 90
Passing 4.75 mm (No. 4) sieve	5.5	30- 56
Passing 1.18 mm (No. 16) sieve	4.5	10- 40
Passing 75 µm (No. 200) sieve	2.5	4- 12
Bitumen	0.5	3- 7
Selected Criteria (CA-10)	Standard Deviation1/	Tolerance2/
Passing 25 mm (1 in.) sieve		100
Passing 12.5 mm (1/2 in.) sieve	6.5	65- 95
Passing 4.75 mm (No. 4) sieve	6.0	40- 60
Passing 1.18 mm (No. 16) sieve	5.0	15- 45
Passing 75 µm (No. 200) sieve	2.5	5- 13
Bitumen	0.5	3- 7

Selected Criteria (CA-12)	Standard Deviation <sup>1/</sup>	Tolerance <sup>2/</sup>
Passing 12.5 mm (1/2 in.) sieve	5.0	90-100
Passing 9.5 mm (3/8 in.) sieve	4.0	75- 95
Passing 4.75 mm (No. 4) sieve	5.0	50- 70
Passing 1.18 mm (No. 16) sieve	4.5	25- 45
Passing 75 µm (No. 200) sieve	2.5	5- 13
Bitumen	0.5	3- 7

1/ Represents the Standard Deviation of the overall population.

2/ Individual tests shall be between these tolerances.

Bituminous concrete Class I, Mixture A, B or C, may be used in leveling the subbase and in areas where small quantities of subbase are required. The Engineer reserves the right to specify the mix to be used.

**312.09 Transportation.** Transportation of bituminous aggregate mixtures shall conform to Article 406.14, except when asphalt cement is used in the mixture, no truck insulation or covering will be required during inclement weather if the mixture can be delivered and placed so that the temperature of the mixture behind the spreader is 95 °C (200 °F) or higher.

**312.10 Placing and Compacting.** After the subgrade has been compacted and is acceptable to the Engineer, the bituminous aggregate mixture shall be spread upon it with a mechanical spreader. The thickness of mixture spread shall be such as to provide a maximum compacted layer of 150 mm (6 in.) provided the required density is obtained. The surface of each layer shall be clean and dry before succeeding layers are placed.

As soon as practical after the layer has been spread, it shall be compacted. The density shall be obtained by an approved vibratory compactor and a roller or by the use of two rollers, except that the compaction may be obtained using equipment which meets the approval of the Engineer provided the density and other requirements contained herein are met. Rollers shall be operated at a speed of not more than 50 m/min (175 ft/min). After compaction, the first layer shall have a density of not less than 88 percent of the theoretical density. Subsequent layers shall be compacted to not less than 90 percent of theoretical density. In small, variable and/or confining areas not to exceed 2500 sq m (3000 sq yd) or 300 m (1000 ft) per day, only one roller will be required. In any case, if the density of a layer is less than required, additional compaction and/or the use of an additional roller will be required.

The maximum theoretical density will be determined by the high pressure air meter, AASHTO T209 or, at the option of the Engineer, it may be computed from the saturated surface dry specific gravity of the aggregate and the specific gravity of the asphalt at 25 °C (77 °F).

The density of each of the finished layers of bituminous aggregate mixture will be obtained by approved nuclear methods or from specimens furnished by the Contractor as specified in Article 406.16. The cost of the work required in taking and transporting the specimens, and in refilling the holes caused by the removal of the

specimens will not be paid for separately, but shall be included in the unit price bid for the type of work specified.

The bituminous aggregate mixture shall be delivered at a temperature of 110 °C (225 °F) to 165 °C (325 °F), except that when a drier drum hot-mix plant is used, the minimum delivery temperature may be 95 °C (200 °F).

When liquid asphalt MC-3000 is used, the foregoing requirements for placing and compacting the bituminous aggregate mixture containing asphalt cement shall apply, except no specific delivery temperature for the bituminous mixture will be required.

Any areas of the subbase which have been damaged shall be repaired by the Contractor at his/her own expense and to the satisfaction of the Engineer.

**312.11 Finishing.** After completion of compaction of the top lift of bituminous aggregate mixture, the subbase, for its entire width, shall be brought to true shape according to Article 311.06 except that wetting and additional rolling will not be required.

**CEMENT AGGREGATE MIXTURE**

**312.12 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 - Materials:

Item	Article/Section
(a) Portland Cement (Note 1) .....	1001.01 - 1001.06
(b) Water .....	1002.01 - 1002.02
(c) Aggregate (Note 2) .....	1004.04

Note 1. Only Type I or Type IA portland cement conforming to Article 1001 .01 shall be used. Bulk cement may be used provided the equipment for handling the cement is approved by the Engineer.

Note 2. The aggregate shall meet the following gradation requirements as determined according to Illinois Modified AASHTO T 27 / T 11:

Passing 25.0 mm (1 in.) sieve .....	100%
Passing 12.5 mm (1/2 in.) sieve .....	60-100%
Passing 4.75 mm (No. 4) sieve .....	55-75%
Passing 2.36 mm (No. 8) sieve .....	40-65%
Passing 75 µm (No. 200) sieve .....	5-15%

When blending is approved, fine material will be permitted in the blend provided that the fine aggregate is Class C quality or higher and the mineral filler complies with the requirements of Article 1011.01. Blending proportions shall not be changed during the progress of the work without permission from the Engineer.

**312.13 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 Equipment:

Item	Article/Section
(a) Three-Wheel Roller (Note 1) .....	1101.01
(b) Tandem Roller (Note 1) .....	1101.01
(c) Tamping Roller (Note 2) .....	1101.01
(d) Pneumatic-Tired Roller .....	1101.01
(e) Trench Roller (Note 3) .....	1101.01
(f) Vibratory Roller .....	1101.01
(g) Subgrade Planer .....	1103.08
(h) Subgrade Machine .....	1103.09
(i) Heavy Subgrade Template .....	1103.10
(j) Cement Aggregate Mixture Equipment .....	1104.01

Note 1. Three-wheel rollers and tandem rollers shall weigh from 5.5 metric tons (6 ton) to 11 metric tons (12 ton) and shall have a compression on the drive wheels of not less than 33 N/mm (190 lb/in.) nor more than 70 N/mm (400 lb/in.) width of roller.

Note 2. In addition to the requirements of Article 1101.01, the tampers shall be long enough to penetrate within 25 mm (1 in.) of the prepared subgrade on the initial rolling.

Note 3. Trench rollers shall be self-propelled and shall develop a compression of not less than 53 N/mm (300 lb/in.) nor more than 70 N/mm (400 lb/in.) of width on the compaction wheel.

## CONSTRUCTION REQUIREMENTS

**312.14 General.** The cement aggregate mixture (CAM) shall be placed only when the air temperature in the shade is above 4 °C (40 °F). No cement aggregate mixture shall be deposited on a frozen or muddy subgrade.

**312.15 Composition.** The Contractor shall, at his/her own expense, submit to the Engineer a minimum of 11 kg (25 lb) of cement and 70 kg (150 lb) of aggregate which the Contractor proposes to use in the mixture at least 60 days prior to the construction of the stabilized subbase. Samples of the materials shall be taken under the supervision of the Engineer. The quantity of portland cement to be added to the aggregate shall be not less than five nor more than eight percent of the oven dry mass (weight) of the aggregate. The actual proportions of cement, water and aggregate material will be set by the Engineer, according to the Department's Geotechnical Manual procedure, before work begins. The proportions will be based on tests conducted on mixtures composed of the samples of the constituent materials furnished by the Contractor. The cement content will be determined in the laboratory according to AASHTO T 135 and AASHTO T 136 and shall be such that the loss in mass (weight) will not be more than ten percent after 12 cycles of wetting and drying and freezing and thawing.

**312.16 Mixing.** The constituents of the mixture shall be accurately proportioned and thoroughly mixed in a mechanical mixer. The control of the mixture

shall be of such accuracy that the quantity of cement shall be within  $\pm 0.3$  percentage points of the amount set by the Engineer.

The measuring devices for proportioning the mixture, either by volume or by weight, shall be of such accuracy that the proportions of the mixture will be maintained within the tolerances set forth in this Specification. The equipment used must be provided with means, meeting with approval of the Engineer, for calibration and check tests of the measuring devices.

In all plants, the water shall be proportioned by weight or volume and there shall be means by which the Engineer may readily verify the amount of water per batch or the rate of flow for continuous mixing.

The Contractor shall provide a platform scale and make arrangements for the use of a certified truck scale of sufficient capacity for calibration and periodic check tests of the feeders or measuring devices as needed during the production.

The mixer shall be capable of producing a uniform mixture. Mixing operations shall be continued until all ingredients are distributed evenly throughout the mixture and a uniform mixture, free of segregation, satisfactory to the Engineer, is obtained. The mixer shall be capable of discharging the mixture without undue segregation.

The moisture content at the time of mixing shall be such that the moisture content at the time of compaction will be within 80 to 110 percent of the optimum moisture determined.

**312.17 Placing and Compacting.** The construction requirements for Subbase Granular Material, Type A, as stipulated in Section 311 shall apply to the construction of the cement aggregate mixture, except as stated. References to granular material in Section 311 shall be construed to include cement aggregate mixture.

The cement aggregate mixture shall be spread for the full width of the subbase.

Depositing and spreading operations shall be conducted so that the total time lapsing from the time water is added to the mixture until compaction is started will be less than 60 minutes. The compaction operations must be started within 30 minutes from the time the material is deposited on the roadbed.

The type, size and number of compactors, and the rate of their operations, shall be such that the section being processed will be fully compacted within two hours of the time that the water is added to the mixture.

If, for any reason, construction operations are delayed or suspended and the Engineer orders any loose or uncompacted material removed and disposed of, the Contractor shall perform this work at his/her own expense.

The cement aggregate subbase may be constructed in one layer. If the density requirement cannot be complied with by placement in a single layer, then the mixture shall be constructed in two approximately equal layers. The first layer shall be maintained in a moistened condition by means of a fine spray until the succeeding



layer is placed. Just prior to placing the second layer, the upper 13 mm (1/2 in.) of the existing layer shall be scarified.

The dry density of the full depth of each compacted layer shall be 100 percent of the standard dry density as determined according to AASHTO T 134 (Method B) on the field mixture, unless the Contractor requests a variance of the first day's cement aggregate mixture placement.

The Department may consider a variance to approve the Contractor's request to establish a mix and procedures providing that the following conditions are agreed to before starting work:

- (a) The mix shall consist of aggregate meeting the requirement for cement aggregate mixtures and seven percent cement.
- (b) A minimum compaction of 98 percent will be accepted provided adjustments in mix or procedures are implemented to achieve a final compaction of 100 percent before the end of the day.
- (c) No variance will be permitted after the first day's placement and 100 percent compaction will be required for all subsequent work.
- (d) If the compaction does not comply with this requirement, the condition shall be corrected or the material replaced to meet the specifications.

The density will be determined for compliance with these specifications by the Engineer according to AASHTO T 191, Illinois Modified AASHTO T 310 (Direct Transmission Density/Backscatter Moisture), or by other methods approved by the Engineer.

The cement aggregate mixture within the section being processed shall be constructed the full width and depth and the surface shall be trimmed and finished within a single working day.

No cement aggregate mixture may be salvaged.

**312.18 Finishing.** When initial compaction of the top layer of the cement aggregate mixture is nearing completion, the surface shall be shaped to the required lines, grades and cross section according to the requirements of Article 311.06, and compaction continued until uniform and adequate compaction is attained. The moisture content of the surface material shall be maintained by means of a fine spray at or slightly above its optimum during all finishing operations and until the curing material is applied.

**312.19 Protection and Cover.** After the cement aggregate mixture has been finished, it shall be protected against drying for a period of seven days by applying a bituminous material. The bituminous material shall be applied as soon as possible after the completion of finishing operations, but in no event shall the finished cement aggregate mixture remain without cover for more than 24 hours. The equipment used for wetting the finished cement aggregate mixture with water or to apply a bituminous protective cover shall be of such limited weight that its use will not cause marring or rutting of the subbase.

The bituminous material used as a protective cover shall be Emulsified Asphalt RS-1, RS-2, CRS-1, CRS-2, Liquid Asphalt RC-70, RC-250, MC-70, MC-250 or High Float Emulsion (HFE) 60, 90, 150 and shall be applied at the rate of approximately 1 L/sq m(0.20 gal/sq yd) uniformly to the surface of the subbase by a pressure distributor to give complete coverage without excessive runoff. The exact rate of application and temperature will be specified by the Engineer. At the time the bituminous material is applied, the surface shall be tightly knit, free of all loose or extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. If needed, water shall be applied to fill the surface voids immediately before the bituminous cover is applied. Should it be necessary for construction equipment or other traffic to use the bituminous covered cement aggregate mixture before the bituminous material has hardened sufficiently to prevent pickup, sufficient sand shall be applied to prevent pickup.

Any finished or completed portion of the subbase which is traveled by construction equipment, or by other traffic, shall be protected in such a manner as to prevent the equipment or other traffic from marring or damaging the completed work.

At any time when the air temperature may be expected to reach the freezing point during the protection period, the subbase shall be protected from freezing with not less than 150 mm (6 in.) of loose, dry straw for seven days after placement or until the cement aggregate mixture has hardened.

After the seven day protection period, the straw shall be removed and disposed of according to Article 202.03.

**312.20 Construction Joints.** At the end of each day's construction, or when construction operations are delayed or suspended and the Engineer so orders, a straight transverse construction joint shall be formed by cutting back into the completed work to form a vertical face. Damage to completed work shall be avoided.

**POZZOLANIC STABILIZED MIXTURE**

**312.21 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 - Materials:

Item	Article/Section
(a) Water .....	1002
(b) Aggregate (Note 1) .....	1004.04
(c) Lime .....	1012
(d) Portland Cement (Note 2) .....	1001
(e) Pozzolan (fly ash) .....	1010.01, 1010.02
(f) Water Reducing Admixture (Note 3) .....	1021
(g) Sand Cover .....	1003.01(a), 1003.01(e)
(h) Bituminous Cure Material .....	1009

Note 1. The gradation requirements as determined according to Illinois Modified AASHTO T 27 / T 11 shall be as follows:

Passing 37.5 mm (1 1/2 in.) sieve	100%
Passing 25 mm (1 in.) sieve	90-100%
Passing 12.5 mm (1/2 in.) sieve	60-100%
Passing 4.75 mm (No. 4) sieve	40- 70%
Passing 425 µm (No. 40) sieve	0- 25%
Passing 75 µm (No. 200) sieve	
(gravel)	0- 10%
(crushed stone and slag)	0- 15%

Alternate gradations will be considered provided mixture design data is furnished to the Department for analysis. Specialized durability testing may be required for unique aggregate gradations or proposed combinations of materials for which the Department does not have historical performance data. Production gradation tolerances shall be as stated in Articles 1003.01 and 1004.01. The coarse or fine aggregate gradation which most nearly resembles the proposed gradation will be utilized for production tolerances.

Boiler Slag. In addition to the aggregates permitted in Article 1004.04, boiler slag may be used. The slag shall be wet-bottom boiler slag produced as a by-product of a power plant burning pulverized bituminous coal. The slag shall be composed of hard durable particles and shall be free of excessive or harmful amounts of foreign substances. Boiler slag in an oven dry condition shall meet the following gradation requirements:

Passing 4.75 mm (No. 4) sieve.....	80-100%
Passing 2.00 mm (No. 10) sieve.....	55- 90%
Passing 425 µm (No. 40) sieve.....	0- 25%
Passing 75 µm (No. 200) sieve.....	0- 10%

Note 2. Only Type 1 or 1A shall be used.

Note 3. A water reducing admixture may be used if permitted by the Engineer. No adjustments will be made in the required lime or cement and pozzolan contents for this addition.

The Contractor shall, at his/her own expense, submit to the Engineer a minimum of 10 kg (25 lb) of lime or cement, 25 kg (50 lb) of fly ash, and 50 kg (100 lb) of the aggregate which the Contractor proposes to use in the mixture. The lime, when sampled, shall immediately be placed in a sealed container and shall be kept sealed. Samples shall be furnished at least 60 days prior to the construction of the subbase. The submitted samples will be tested for individual acceptance, for making design mixes, and for determining a tentative placement cut-off date.

**312.22 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Three-Wheel Roller (Note 1) .....	1101.01
(b) Tandem Roller (Note 1) .....	1101.01
(c) Tamping Roller (Note 2) .....	1101.01
(d) Pneumatic-Tired Roller .....	1101.01
(e) Trench Roller (Note 3) .....	1101.01
(f) Vibratory Roller .....	1101.01
(g) Pozzolan Aggregate Mixture Equipment .....	1104.01
(h) Mechanical Spreader (Note 4)	
(i) Wheel Saw (Note 5)	
(j) Subgrade Planer .....	1103.08
(k) Subgrade Machine .....	1103.09
(l) Heavy Subgrade Template .....	1103.10

Note 1. Three-wheel rollers and tandem rollers shall weigh from 5.5 metric tons (6 ton) to 11 metric tons (12 ton) and shall have a compression on the drive wheels of not less than 33 N/mm (190 lb/in.) nor more than 70 N/mm (400 lb/in.) width of roller.

Note 2 In addition to the requirements of Article 1101.01, the tampers shall be long enough to penetrate within 25 mm (1 in.) of the prepared subgrade on the initial rolling.

Note 3. Trench rollers shall be self-propelled and shall develop a compression of not less than 53 N/mm (300 lb/in.) nor more than 70 N/mm (400 lb/in.) of width on the compaction wheel.

Note 4. The mechanical spreader shall be self-propelled and equipped with automatic screed and grade sensing controls which control the longitudinal grade and transverse slope of the screed. Screed controls shall be such that compensation for differences from the established slope and grade will be completely automatic. The screed shall be adjustable to produce the required cross section.

Note 5. The saw shall be capable of cutting the required joints to the width and depth shown on the plans, perpendicular to the pavement surface, and without excessive spalling or raveling.

**CONSTRUCTION REQUIREMENTS**

**312.23 General.** The activator for pozzolan stabilized mixture shall either be cement or lime at the option of the Contractor and the mixture shall be constructed between April 15 and October 15, except when lime fly ash is used, the transition date indicated in TABLE A will apply. Mixtures shall only be constructed when the air temperature in the shade is above 4 °C (40 °F).

The Contractor shall request, in writing, specific mixture design modifications for extension of the October 15 or transition dates in Table A. Samples of ingredient materials and request for verification shall be submitted to the Engineer by September 15 for cement activator and by August 15 for lime activator. Approval will be based on consideration of the cured strength development characteristics as determined by the Department's Geotechnical Manual procedure and the predicted curing degree days. The Department may extend the construction season beyond the transition dates indicated for lime fly ash mixture. In no case shall cement fly ash subbase be constructed after November 7 in the Northern Zone (Districts 1 - 4) and after November 15 in the Southern Zone (Districts five - 9).

The amount of pozzolanic stabilized mixture constructed shall be limited to that which can be surfaced during the current construction season. No mixture shall be deposited on a frozen or muddy roadbed. The Contractor shall assure the Department that sufficient quantities of inspected ingredient material are available to complete the work.

TABLE A TRANSITION DATES FOR POZZOLANIC STABILIZED MIXTURE		
Required Compressive Strength, kPa (psi) 4/ (14 Day Cure @ 22 °C)		
Transition Date 1/	Northern Zone 2/	Southern Zone 3/
Sept. 15	4,800 (700)	4,500 (650)
Oct. 1	5,800 (850)	4,800 (700)
Oct. 15	6,500 (950)	5,800 (850)

- 1/ The transition date must be verified by samples, representing July production, submitted to the Department by August 15 for testing.
- 2/ Districts 1, 2, 3, 4.
- 3/ Districts 5, 6, 7, 8, 9.
- 4/ According to AASHTO T 22, with no correction for the length-to-diameter ratio.

**312.24 Composition.** The cement or lime, pozzolan, and aggregate shall be proportioned within the following approximate limits on a dry weight basis:

APPROXIMATE PERCENT BY WEIGHT OF OVEN DRY AGGREGATE		
Ingredient	Gravel, Crushed Stone, Crushed Slag or Aggregate Blend	Boiler Slag
Cement	3 to 5	3 to 6
Lime	3.5 to 6	3.5 to 6
Pozzolan	9 to 20	18 to 40
Aggregate	74 to 88.5	54 to 79.5

The actual proportions of lime or cement, pozzolan, water and aggregate will be set by the Engineer before work begins. The actual proportions will be based on tests conducted on sample mixtures of the constituent materials furnished by the Contractor. The Department's Geotechnical Manual procedure will be utilized (available on request). The composition of the mixture will be such that when molded into cylinders (as prescribed in the Department's Geotechnical Manual procedure) and cured at 22 °C ± 1 °C (72 °F ± 2 °F) (14 day cure), the cylinders will have a minimum average compressive strength of 4,100 kPa (600 psi) according to AASHTO T 22 with no correction for the length-to-diameter ratio; with no individual test below 3,400 kPa (500 psi). The right is reserved by the Engineer to make changes in proportions during the progress of the work as the Engineer may consider necessary.

**312.25    Mixing.** Mixing shall be accomplished according to Article 312.16, except the control of the mixture shall be of such accuracy that the proportions of the mixture based on total dry weight will be maintained within the following tolerances:

Cement/Lime .....	±0.5 percent by weight
Pozzolan .....	±1.5 percent by weight
Aggregate .....	±2.0 percent by weight

If a water reducing admixture is used, the automatic dispensing system shall be capable of continuously introducing the desired quantity of admixture within the range of ±0.11 L/min (±0.03 gal/min).

When cement fly ash is constructed, mixing and spreading operations shall be coordinated such that nor more than 90 minutes shall elapse from the time water is added to the mixture and compaction operations are begun.

**312.26    Placing, Compacting, and Finishing.** The mixture shall be placed on subgrade meeting the requirements of Section 301. The Contractor shall have, at all times, at least 240 m (800 ft) of subgrade prepared in advance of the subbase placement. The pozzolanic stabilized mixture shall be constructed in layers not more than 100 mm (4 in.) thick when compacted. If tests indicate that the desired results are being obtained, the compacted thickness of any layer may be increased to a maximum of 200 mm (8 in.) for lime fly ash and 300 mm (12 in.) for cement fly ash. When the thickness specified is more than maximum thickness, the mixture shall be placed in two or more approximately equal layers. Each layer shall be deposited full width directly on the prepared subgrade or on the preceding layer of compacted mixture with a mechanical spreader or spreader box of a type approved by the Engineer. Where the mixture must be placed in more than one layer, the previous layer shall be maintained in a moistened condition until the succeeding layer is placed. After having been tested for density and approved by the Engineer, the previous layer shall be dampened with water, if required by the Engineer. The second layer shall be placed the same day as the first layer. When placed, the pozzolanic stabilized mixture shall be free from segregation and shall require minimum blading and manipulation.

Particular care shall be exercised to ensure satisfactory density along the edges of the section and adjacent to construction joints. The type, size and number of compactors and the rate of their operation shall be such that the section being processed will be fully compacted within three hours of the time water is added to the mixture. The first layer of the subbase shall be compacted to at least 97 percent of

maximum density. The succeeding layers of subbase shall be compacted to 100 percent of maximum density. The maximum density will be determined according to AASHTO T 180, Method C, except that the five lift requirement is replaced with three lifts.

The density of each layer of the compacted subbase will be determined by the Engineer for compliance with these Specifications according to AASHTO T 191, Illinois Modified AASHTO T 310 (Direct Transmission Density/Backscatter Moisture), or by other methods approved by the Engineer. If these tests indicate that the layer does not comply with the density requirements, the condition shall be corrected or the material replaced to meet these Specifications.

In constructing the top layer, the grade shall be kept at sufficient height so that the top surface, when compacted, will be at or slightly above grade, rather than below grade. Finish grading shall be accomplished by removing excess material followed by recompaction by rolling. In the event that low areas occur, they shall be reconstructed to the satisfaction of the Engineer.

If any subgrade material is worked into the pozzolanic stabilized mixture during the compacting or finishing operations, all pozzolanic mixture within the affected area shall be removed and replaced with new material. Any finished or completed portion of the subbase which is traveled by construction equipment, or by other traffic, shall be protected in such a manner as to prevent the equipment or other traffic from marring or damaging the completed work. The Engineer may restrict hauling over partially completed work or uncured subbase after inclement weather or at any time when the subgrade is soft and there is a tendency for the subgrade material to work into the pozzolanic stabilized mixture.

When initial compaction of the mixture is nearing completion, the surface of the subbase shall be shaped to the required lines, grades, and cross section. The moisture content of the surface of the subbase mixture shall be maintained at or slightly above its specified optimum during all finishing operations and until the curing material is applied.

Surface compaction and finishing shall be done in such a manner as to produce a smooth, closely knit surface, relatively free from cracks, ridges, low spots, or loose material. The finished surface shall be tested for crown and elevation by means of a template and shall meet the tolerance in thickness requirement as stated herein.

If for any reason construction operations are delayed or suspended and the Engineer orders any loose or uncompacted material removed and disposed of, the Contractor shall perform this work at the his/her own expense. No pozzolanic stabilized mixture may be salvaged.

**312.27 Curing.** After the pozzolanic stabilized mixture has been constructed, the surface shall be kept continuously moist until the bituminous curing cover is applied. The bituminous curing cover shall be applied no later than 24 hours following final compaction unless in the judgment of the Engineer, it should be delayed. The materials and application of the curing cover shall be according to the requirements of Article 312.19 for bituminous protective cover.

Paving may proceed after the curing cover has been applied and cured to the satisfaction of the Engineer. At least 14 hours for lime fly ash and 12 hours for cement fly ash shall elapse between the time the curing cover material is applied and paving begins.

**312.28 Construction Joints and Maintenance.** At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a vertical face. If the cement fly ash subbase paving operations are discontinued for more than 24 hours or when the mixture has taken a set prior to the achievement of acceptable compaction, a longitudinal and/or transverse saw joint shall be cut and the material in the affected area shall be removed and disposed of according to Article 202.03. Damage to completed work shall be avoided.

In areas where irregular width, inaccessibility, or unavoidable obstacles make the use of mechanical spreading equipment impractical, such equipment will not be required, and the Contractor may use other methods approved by the Engineer. If full-width placement is impractical, placing the adjacent pass(es) with the specified mechanical spreader to achieve the desired pavement width must be completed the same day as placement of the first pass.

The contractor shall maintain at his/her own expense, the entire subbase in a manner satisfactory to the Engineer until the pavement has been completed. Maintenance shall include immediate repairs of any defective or damaged portions of the subbase. Repairs or replacements shall be made in such a manner as to ensure restoration of a uniform surface and durability of the portion repaired or replaced. The Contractor shall also remove and replace full-depth, at the Contractor's own expense, any pozzolanic aggregate mixture which is unsatisfactory due to its being placed over excessively wet or otherwise unstable subgrade; damaged by rain, freezing or other climatic conditions; damaged by traffic; or which is unsatisfactory due to failure to comply with any of the requirements specified.

**CEMENT AGGREGATE MIXTURE II**

**312.29 Materials.** Materials for Cement Aggregate Mixture II shall meet the requirements of the following Articles of Section 1000 - Materials.

Item	Article/Section
(a) Coarse Aggregate (Note 1) .....	1004.01-1004.02
(b) Fine Aggregate (Note 2) .....	1003.01-1003.02
(c) Portland Cement (Note 3) .....	1001
(d) Water .....	1002
(e) Curing Materials (Note 4) .....	1022
(f) Emulsified Asphalt (Note 5) .....	1009.07
(g) Concrete Admixture .....	1021.01-1021.04
(h) Fly Ash .....	1010.03

Note 1. Coarse aggregate shall be gradation CA-6, CA-7, CA-10 or CA-11, Class D quality or better.

Note 2. Fine aggregate shall be FA-1 or FA-2.



Note 3. Portland Cement Type 1 shall be used.

Note 4. Membrane Curing Compound shall be Type III.

Note 5. RS-1, RS-2, CRS-1 or CRS-2 shall be used.

**312.30 Equipment.** Equipment shall meet the requirements of Article 420.03.

## CONSTRUCTION REQUIREMENTS

**312.31 Proportioning.** At least 60 days prior to start of placing CAM II, the Contractor shall submit samples of materials for proportioning and testing. The mixture shall contain a minimum of 120 kg (200 lb) of portland cement per cubic meter (cubic yard), except that a maximum of 15 percent of cement may be replaced by fly ash at a 1:1.5 cement-to-ash ratio (weight basis). Blends of coarse and fine aggregates will be permitted, provided the volume of fine aggregate does not exceed the volume of coarse aggregate. The Engineer will determine the proportions of materials for the mixture.

Air-entraining admixture and water-reducing admixture shall be added. Water-reducing admixtures shall be added to the mixer separately from air-entraining admixtures according to the manufacturer's printed instructions. The air-entrainment agent and the other admixture(s) shall be compatible. The water and air content of freshly mixed air-entrained CAM II shall be based upon trial mixes with the materials to be used in the work adjusted to produce a mixture of the required plasticity, workability and durability. The mixture shall have a relative durability of 80 percent at 100 cycles when tested according to AASHTO T 161 Procedure B. The percentage of air-entrainment shall not be less than seven percent or more than ten percent. Air content shall be determined according to Article 1020.08. The mix shall have a slump of 25 mm (1 in.) to 75 mm (3 in.). Slump shall be determined according to Article 1020.07.

**312.32 Mixing and Placing.** CAM II shall be mixed according to Article 1020.11 (c). No CAM II shall be deposited on a frozen or muddy subgrade or when the air temperature in the shade is less than 4 °C (40 °F). Forms and form setting shall conform to Article 420.06 or as approved by the Engineer. The use of a mechanical form tamper will not be required. When a slipform paver will be used for placing the portland cement concrete or continuously reinforced portland cement concrete pavement, the CAM II subbase shall be constructed to a width 150 mm (6 in.) wider than the width outside-to-outside of the slipform paver's tracks. When this results in a width greater than shown on the plans or typical section, such extended width will not be measured for payment but shall be included in the unit price bid for the CAM II subbase. Placing CAM II shall conform to the requirements of Article 420.07, except that a mechanical concrete spreader will not be required. Vibratory screeds will be permitted. Slipform paving methods may be used, provided the requirements of Article 420.17, paragraphs 1, 2, 7 and 10 are met.

**312.33 Finishing and Testing.** After the CAM II subbase has been struck off and consolidated, and while it is still plastic, the surface including the paver trackline shall not have variations of more than 5 mm (3/16 in.) in 3 m (10 ft) measured parallel

with the centerline of pavement. Any depressions shall immediately be filled with fresh CAM II mix, struck off, consolidated and refinished. Bumps shall be cut off and the area refinished. The finished surface shall not be textured, but shall be closed.

CAM II samples shall be furnished by the Contractor and shall be taken from unconsolidated material on grade to determine the air content or slump. Testing shall be according to Article 1020.07 and 1020.08.

**312.34 Curing.** Immediately after the finishing operations have been completed, the surface shall be cured and protected according to Articles 1020.13(a)(4), 1020.13(c) and 1101.09. All areas of membrane curing compound damaged by rain or other cause within the required three day curing period shall be repaired by applying another coat as above. Membrane curing compound damaged after the three-day curing period shall be repaired with membrane curing compound as above or with emulsified asphalt applied at the approximate rate of 1 L/sq m (0.20 gal/sq yd) to the surface with a pressure distributor meeting the requirements of Article 1102.05.

**312.35 Protection.** Minor construction traffic will not be permitted on the completed subbase for at least three days and no batch or haul trucks will be permitted on the completed subbase unless approved by the Engineer. The Contractor shall remove and replace at the Contractor's own expense any CAM II mixture which is unsatisfactory due to rain, freezing or other climatic conditions; damaged by traffic; or which is unsatisfactory due to failure to comply with any of the requirements specified.

### STABILIZED SUBBASE – GENERAL

**312.36 Tolerance in Thickness.** The subbase shall be constructed to the thickness shown on the plans. Determination for the subbase thickness will be based on thickness measurements, taken either at cored points or at the edge of the subbase. When the constructed thickness is less than 90 percent of the specified thickness, it shall be brought to the specified thickness by increasing the thickness of portland cement concrete pavement or removal and replacement with new mixture at no additional cost, except for the following:

- (a) Bituminous Aggregate Mixture Subbase – correction with additional Bituminous aggregate mixture will be allowed.
- (b) When continuously reinforced concrete pavement is to be constructed – correction shall be only by removal and replacement.

The surface elevation of the completed subbase, shall not exceed by more than 5 mm (3/16 in.) the surface elevation shown on the plans or authorized by the Engineer.

**312.37 Method of Measurement.**

- (a) Contract Quantities. The requirements for the use of Contract Quantities shall conform to Article 202.07(a).

- (b) **Measured Quantities.** Stabilized subbase of the thickness specified will be measured for payment in place and the area computed in square meters (square yards). The width for measurement will be from outside to outside of the top of the final layer of the completed work as shown on the plans or as directed by the Engineer. The liquid asphalt for the curing coat for either the cement aggregate mixture or pozzolanic aggregate mixture, and any sand cover required will not be measured for payment.

**312.38 Basis of Payment.** This work will be paid for at the contract unit price per square meter (square yard) for STABILIZED SUBBASE of the thickness specified, which price shall be payment in full for the work constructed including any liquid asphalt or sand for curing coat.

## BASE COURSE

### SECTION 350. LIME STABILIZED SOIL MIXTURE

**350.01 Description.** This item shall consist of the construction of a lime stabilized soil mixture composed of "reactive soil", lime, and water which shall be considered as base course. The work shall be performed and measured and paid for according to the requirements of Section 310, except that the lime-soil mixture used shall provide a minimum laboratory average compressive strength of 1000 kPa (150 psi), according to AASHTO T 208. The references in Section 310 to subbase shall be construed to include base course.

### SECTION 351. AGGREGATE BASE COURSE

**351.01 Description.** The base course shall consist of furnishing one or more courses of aggregate on a prepared subgrade or subbase.

**351.02 Materials.** Materials shall meet the requirements of the following Article of Section 1000 - Materials:

Item	Article/Section
(a) Aggregate .....	1004.04

**351.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Tamping Roller .....	1101.01
(b) Pneumatic-Tired Roller .....	1101.01
(c) Three-Wheel Roller (Note 1) .....	1101.01
(d) Tandem Roller (Note 1) .....	1101.01
(e) Spreader .....	1102.04
(f) Vibratory Machine (Note 2)	

Note 1. Three-wheel or tandem rollers shall weigh from 5.5 metric tons (6 ton) to 9 metric tons (10 ton) and shall weigh not less than 35 N/mm (200 lb/in.) nor more than 57 N/mm (325 lb/in.) of width of the roller.

Note 2. The vibratory machine shall meet the approval of the Engineer.

### CONSTRUCTION REQUIREMENTS

**351.04 Subgrade.** The subgrade shall be prepared according to Section 301 except Articles 301.05 and 301.06 will not apply.

**351.05 Base Course.** The construction of the base course shall conform to the following requirements:

- (a) General. The aggregate shall be uniform in gradation. Wetting the aggregate in cars, bins, stockpiles or trucks will not be permitted.

The base course shall be constructed in layers not more than 100 mm (4 in.) thick when compacted, except that if tests indicate that the desired results are being obtained, the compacted thickness of any layer may be increased to a maximum of 200 mm (8 in.). The aggregate shall be deposited full-lane width, directly on the prepared subgrade or on the preceding layer of compacted aggregate with a spreader. When placed, it shall be free from segregation and shall require minimum blading or manipulation. Immediately after the material has been placed, it shall be compacted with a tamping roller, or with a pneumatic-tired roller, or with a vibratory machine, or with a combination of any of the three. The top layer shall be given a final rolling with a three-wheel or tandem roller. The manner of compaction shall be approved by the Engineer.

If any subgrade material is worked into the base material during the compacting or finishing operations, all granular material within the affected area shall be removed and replaced with new aggregate. The Engineer may restrict hauling over the completed or partially completed work after inclement weather or at any time when the subgrade is soft and there is a tendency for the subgrade material to work into the base material.

- (b) Type A. The aggregate used for preparing Type A Base Course shall have a bearing ratio of not less than 80, except that if the aggregate used is crushed gravel, crushed stone or crushed slag, the bearing ratio will not be required.

The bearing ratio will be determined according to the Standard methods adopted by the Department.

The Contractor shall, at his/her own expense, submit to the Engineer, a sample of the aggregate to be used for Aggregate Base Course, Type A, at least 15 days prior to starting construction. The sample so submitted will be tested by the Department for acceptance.

Before the aggregate is deposited on the subgrade, it shall contain the amount of moisture required for compaction. The amount of moisture

required shall be that determined by the Engineer for the material and compaction methods being used. The water and aggregate shall be mixed at a central mixing plant. The plant shall be equipped with a mechanical mixing device, and aggregate and water measuring devices, meeting the approval of the Engineer.

The granular material shall be compacted to not less than 100 percent of the standard laboratory density. The standard laboratory density shall be the maximum dry density determined according to AASHTO T 99 (Method C). A coarse particle correction according to AASHTO T 224 shall be used.

The dry density of the compacted Base Course, Type A, will be determined by the Engineer at regular intervals according to AASHTO T 191, Illinois Modified AASHTO T 310 (Direct Transmission Density/Backscatter Moisture), or by other methods approved by the Engineer.

If these tests indicate that the base course does not comply with the density requirements, additional wetting, if necessary, and rolling will be required until the density is obtained. Moisture shall be added to the material during compaction only when it is necessary to increase the percentage of moisture to obtain the required density.

- (c) Type B. The moisture content for Type B base course shall be sufficient to prevent segregation of the aggregate. Water shall be added as required by the Engineer to obtain compaction satisfactory to the Engineer. The use of a central mixing plant to obtain moisture sufficient for compaction will be permissible.

**351.06 Tolerance in Thickness.** The base course shall be constructed to the thickness shown on the plans. Thickness determinations will be made at such points as the Engineer may select. When the constructed thickness is less than 90 percent of the specified thickness shown on the plans, aggregate shall be added to obtain the required specified thickness.

**351.07 At Bridges, Railroad Grade Crossings and Existing Pavement.** The base course adjacent to bridges, railroad grade crossings and existing pavement shall be 75 mm (3 in.) (compacted) greater in depth than the typical section, with the surface at the established grade. The width at bridges and railroad grade crossings shall be the same as the typical section. At existing pavement, the width shall be as shown on the plans or as directed by the Engineer. This 75 mm (3 in.) increase in depth shall be made at a uniform rate in a distance of 15 m (50 ft). The cost of excavation in this transition shall be considered as included in the cost of the base course.

**351.08 At Side Roads, Entrances and Mailboxes.** The material used at side roads, entrances and mailbox turnouts shall be the same as that used to construct the base course.

After the shoulders have been completed, the subgrade shall be excavated and the bottom of the excavation shall be compacted in a manner approved by the Engineer. The earth excavated in preparing the subgrade shall be disposed of within

the right of way, as directed by the Engineer, within a distance of 300 m (1000 ft) from the place of excavation.

The excavation, preparation of subgrade and disposal of surplus excavation shall be considered as included in the cost of the base course.

**351.09 Shaping, Trimming, Finishing and Opening to Traffic.** All shaping, trimming and finishing shall conform to Section 212. The road shall be opened to traffic according to Article 701.05(b)(1).

**351.10 Maintaining.** The Contractor shall maintain the base course until the entire section is accepted. In no case shall the maintenance period be less than ten days for any portion of the road.

In lieu of the above specified minimum ten day maintenance period, the Contractor, at his/her option, may elect to proof roll the completed aggregate base course. The test vehicle for proof rolling shall consist of a tandem axle truck loaded to a minimum gross weight of 18100 kg (40,000 lb). Proof rolling shall consist of 40 passes in each lane of the completed aggregate base course. Any failures in the base that occur during the proof rolling shall be immediately repaired and shall be subjected to an additional five passes of the test vehicle after the initial 40 passes are completed. This process shall be repeated, if necessary, until all failed areas pass the proof rolling.

**351.11 Method of Measurement.** Aggregate used for base course will be measured for payment in metric tons (tons), cubic meters (cubic yards), or square meters (square yards) of the thickness specified. Aggregate used for maintenance will be measured for payment in metric tons (tons). The unit of measurement will be shown on the plans.

Water required to be added for compaction on the grade will not be measured for payment but shall be considered as included in the cost of the item of work being constructed.

The requirements for the use of contract quantities and measured quantities shall conform to Article 311.08(a) and 311.08(b), respectively.

**351.12 Basis of Payment.** This work will be paid for at the contract unit price per metric ton (ton), or cubic meter (cubic yard), for AGGREGATE BASE COURSE, TYPE A, or AGGREGATE BASE COURSE, TYPE B, or at the contract unit price per square meter (square yard) for AGGREGATE BASE COURSE, TYPE A or AGGREGATE BASE COURSE, TYPE B of the thickness specified.

Additional aggregate required for maintenance will be paid for at the contract unit price per metric ton (ton) for AGGREGATE BASE COURSE, TYPE A, or AGGREGATE BASE COURSE, TYPE B.

Except as specified above for the additional aggregate required for maintenance, the work of maintaining or proof rolling the completed aggregate base will not be paid for separately, but shall be considered as included in the unit prices bid for the construction items involved, and no additional compensation will be allowed.

**SECTION 352. SOIL-CEMENT BASE COURSE**

**352.01 Description.** This work shall consist of a construction of a soil-cement base course composed of soil, portland cement and water.

**352.02 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 - Materials:

Item	Article/Section
(a) Portland Cement (Notes 1 & 2) .....	1001
(b) Soil (Note 3)	
(c) Water .....	1002

Note 1. Bulk cement may be used for the traveling mixing plant method if the equipment for handling, weighing and spreading the cement is approved by the Engineer.

Note 2. Either Type 1 or Type 1A Portland cement shall be used.

Note 3. The soil incorporated in the soil-cement base course shall consist of the existing soil in the roadway, imported soil, or a mixture of both, approved by the Engineer. Imported soil used in the base course shall all pass a 37.5 mm (1 1/2 in.) sieve and shall contain not more than 15 percent retained on a 25 mm (1 in.) sieve. The base course material, whether consisting entirely of existing roadway soil, imported soil, or a mixture of both, shall all pass a 75 mm (3 in.) sieve and not more than 45 percent shall be retained on the 4.75 mm (No. 4) sieve.

**352.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Pressure Distributor .....	1102.05
(b) Pneumatic-Tired Roller .....	1101.01(a)
(c) Rotary Speed Mixer .....	1101.06
(d) Tamping Roller (Note 1) .....	1101.01(d)
(e) Tandem Roller (Note 2) .....	1101.01(e)
(f) Three-Wheel Roller (Note 2) .....	1101.01(e)
(g) Traveling Mixing Plant (Note 3) .....	1101.07

Note 1. In addition to the requirements of Article 1101.01(d), the tampers shall be long enough to penetrate within 25 mm (1 in.) of the subgrade on the initial rolling.

Note 2. Three-wheel rollers and tandem rollers shall weigh from 5.5 metric tons (6 ton) to 9 metric tons (10 ton) and shall weigh not less than 35 N/mm (200 lb/in.) nor more than 57 N/mm (325 lb/in.) width of roller

Note 3. When more than 10000 sq m (12,000 sq yd) of soil-cement base course are to be processed, a traveling mixing plant will be required together with any machine, or combination of machines, or equipment which will

produce in one pass completed soil-cement base course meeting the requirements of these Specifications. Mixing devices approved by the Engineer may be used when less than 10000 sq m (12,000 sq yd) of soil-cement base course are to be processed.

Note 4. The vibratory machine shall meet the approval of the Engineer.

**352.04 Composition, Moisture-Density Tests and Control Factors.** When imported soil is used in the base course, the Contractor shall, at his/her own expense, submit to the Engineer a minimum of 10 kg (25 lb) of cement and 70 kg (150 lb) of base material which the Contractor proposes to use in the mixture. These materials shall be furnished at least 60 days prior to the construction of the soil-cement base course and will be used to determine preliminary proportion of the mixture composition. Samples of the materials shall be taken under the supervision of the Engineer.

The actual proportions of cement, water and soil material will be set by the Engineer, according to the Department's Geotechnical Manual procedure, before work begins. The proportions will be based on tests conducted on mixtures composed of constituent materials to be incorporated into the soil-cement base course. Samples of the mixture will be tested according to AASHTO T 135 and AASHTO T 136, and the maximum allowable losses as determined by either of these tests shall be as follows:

Soil Group Classification	Maximum Allowable Loss (%)
A-1, A-2-4, A-2-5, A-3 .....	14
A-2-6, A-2-7, A-4, A-5 .....	10
A-6, A-7.....	7

The soil material will be classified according to AASHTO M 145. The right is reserved by the Engineer to make such changes in proportion during the progress of the work as the Engineer may consider necessary.

In addition to meeting the requirements of the above durability tests, the design mixture shall have a seven day compressive strength of not less than the design strength specified. The design strength will be based on laboratory specimens prepared according to AASHTO T 134 (Method B) which have been moist-cured for seven days. The specimens shall be capped and soaked four hours immediately prior to testing. The compressive strength shall be determined according to AASHTO T 22, with no correction for the length-to-diameter ratio.

The optimum moisture content and standard laboratory density will be determined according to AASHTO T 134 (Method B).

**CONSTRUCTION REQUIREMENTS**

**352.05 General.** The soil-cement base course shall be placed only when the temperature of the subgrade, measured 50 mm (2 in.) to 75 mm (3 in.) below the



surface, is above 10 °C (50 °F), and the air temperature in the shade is above 4 °C (40 °F).

**352.06 Preparation.** The area to be processed shall be carefully shaped to the proper grade and cross section and shall be void of all vegetation and other objectionable material.

The subsoil under the area to be processed shall be firm and capable of supporting, without displacement, the equipment used in the construction of the soil-cement base, and also other traffic, prior to acceptance of the preparation work. Any soft or unstable subsoil shall either be made stable or removed and replaced with suitable material. If the unstable subsoil is stabilized with cement, the provisions of this Specification shall apply except as modified by the Engineer. If the unstable subsoil is removed and the plans or Special Provisions do not show the method of disposal of the unstable soil, it shall be used to widen embankments, flatten slopes or be disposed of as directed by the Engineer.

**352.07 Pulverizing.** When necessary, the soil to be processed shall be scarified and pulverized prior to the application of the cement. Pulverizing shall be continued until the soil meets the gradation requirement specified in Article 352.10 and the moisture content of the soil does not exceed that which will permit a uniform mixture of soil and cement.

**352.08 Spreading Cement.** The quantity of cement as determined under Article 352.04 shall be uniformly spread on the soil with a mechanical spreader in a manner satisfactory to the Engineer. The spreading operations shall be limited to such an area that all the operations specified in Articles 352.08 to 352.11, inclusive, will be continuous and completed during the daylight hours; and the operations specified in Articles 352.09 to 352.11 inclusive, completed in six hours.

No cement shall be spread unless the soil and subgrade meet the requirements of Articles 352.05, 352.06 and 352.07, and the percentage of moisture in the soil does not exceed the quantity which will permit a uniform mixture of soil and cement during the mixing operations.

No equipment except that used in spreading and mixing will be allowed to pass over the spread cement and this equipment shall be operated in such a manner as to avoid displacement of cement.

Cement which has been damaged by hydration due to rain prior to or during the mixing operations, which has been damaged while spread contrary to the above mentioned requirements, or which has been displaced by the Contractor's equipment or other traffic, shall be replaced by the Contractor at his/her own expense.

**352.09 Dry Mixing.** Dry mixing of soil and cement is required when mixing equipment other than a traveling mixing plant is used. After the cement is spread, it shall be mixed with the pulverized soil. No cement shall be mixed below the desired depth. Mixing shall be accomplished with mixing devices approved by the Engineer and shall be continued until the resulting mixture is homogeneous and uniform in appearance.

The mixing operations shall be confined within the spill over of material on the shoulders shall be avoided.

When any of the operations from the start of soil and cement mixing through final compaction are interrupted for more than 30 minutes for any reason, the entire thickness of the base course shall be thoroughly loosened, reprocessed, and shall be completed within the specified time limits for these operations. When the uncompacted soil-cement mixture is wet by rain so that the average moisture content exceeds the tolerance given in Article 352.10 at the time of final compaction, the portion being processed shall be reconstructed according to this Specification and at the expense of the Contractor.

### **352.10 Moist Mixing.**

- (a) With Equipment Other Than a Traveling Mixing Plant. If a traveling mixing plant is not used, water shall be immediately applied uniformly and incorporated into the dry-mixed soil and cement in quantities which will produce the required moisture content for the soil-cement mixture.

Water supply and pressure distributing equipment shall be provided which will ensure the application of all water required on the section being processed within three hours. Each application or increment of water shall be at least partially incorporated into the mixture if necessary to avoid excessive concentration of water on and near the surface.

After the last increment of water has been added, mixing shall be continued until a uniform mixture of soil, cement and water is obtained. Particular care shall be exercised to ensure satisfactory moisture distribution along the edges of the section and for the full depth of treatment.

When water application and moist mixing is completed, the percentage of moisture in the fraction of the mixture passing a 25 mm (1 in.) sieve, on a basis of dry weight, shall be between 80 and 100 percent of the optimum moisture content for sandy soils, and between 100 and 120 percent of the optimum moisture content for silty and clayey soils. At completion moist mixing, 100 percent of the soil shall pass a 25 mm (1 in.) sieve and at least 80 percent shall pass a 4.75 mm (No. 4) sieve, exclusive of gravel or stone retained on these sieves.

- (b) With a Traveling Mixing Plant. After the cement is spread, it shall be mixed with soil and water with a traveling mixing plant. No mixing shall be done below the desired depth. Mixing shall be at such rate that, or shall be repeated until, a uniform mixture of soil, cement and water is obtained. Particular care shall be exercised to ensure a satisfactory mixture along the edges of the section and for the full depth of treatment. At the completion of the mixing operation, the moisture content and gradation of the mixture shall be as specified in Article 352.10(a).

**352.11 Compaction and Finishing.** Compacting the soil-cement mixture shall be a continuation of the moist mixing operation in such a manner that the soil-cement mixture does not remain undisturbed after mixing and before compacting for more than 30 minutes. Prior to the beginning of compaction, the mixture shall be in a

loose condition for its full depth and width. The mixture shall then be uniformly compacted with tamping rollers in conjunction with other compaction equipment until the specified density has been obtained. Particular care shall be exercised to ensure satisfactory density along the edges of the section and adjacent to construction joints. The type, size, and number of compactors, and the rate of their operation, shall be such that the section being processed can be compacted within two hours.

When initial compaction of the soil-cement mixture is nearing completion, the surface of the base course shall be shaped to the required lines, grades and cross section, and compaction continued until uniform and adequate compaction is obtained. If necessary to attain satisfactory surface grade, the surface shall be lightly scarified with a nail drag, spike-tooth harrow or weeder, and reshaped. The resulting surface then shall be thoroughly rolled with a three-wheel or tandem roller, or a pneumatic-tired roller, or both, of the size and type specified in Article 352.03, Equipment, and meeting the needs of the work. The moisture content of the surface material shall be maintained at or slightly above its specified optimum during all finishing operations and until the curing material is applied.

Surface compaction and finishing shall be done in such a manner as to produce a smooth, closely knit surface, relatively free from cracks, ridges, low spots, or loose material, conforming to the crown, grades, and lines shown on the plans. When directed by the Engineer, surface finishing methods may be varied provided a smooth, dense, uniform surface, free of surface compaction planes, is produced.

The dry density of the soil-cement base course will be determined by the Engineer near the end of the finishing operations. Any portion of the base course that has a density less than 95 percent of the standard laboratory density or which is 13 mm (1/2 in.) thicker or thinner than the required thickness, shall be corrected or removed and replaced to meet this Specification. The standard laboratory density for field control of mixed-in-place soil-cement will be determined according to AASHTO T 134 (Method B).

The drying apparatus for moisture determination for field control will consist of a stove, an oven and other suitable equipment.

The in-place dry density of the compacted soil-cement base course will be determined by the Engineer at regular intervals according to AASHTO T 191, Illinois Modified AASHTO T 310 (Direct Transmission Density/Backscatter Moisture), or by other methods approved by the Engineer.

The completed and cured base course will be tested for soundness by the Engineer by dropping a mattock handle from a perpendicular position. Any portion of the base course which does not produce a solid ring when so tested, or which does not produce a good rebound of the mattock handle will be further investigated. Any correction or replacement directed by the Engineer according to this Article shall be considered as included in the cost of the work and will not be paid for directly.

**352.12 Protection and Cover.** After the soil-cement base course has been finished as specified herein, it shall be protected against drying for a period of seven days by applying a bituminous material according to the requirements of Article 312.19 except that the bituminous material shall be applied as soon as possible after the completion of finishing operations, but in no event shall the finished soil-cement

base course remain without cover for more than 44 hours unless prolonged rain intervenes. The reference in Article 312.19 to cement aggregate mixture and to subbase shall be construed to include soil-cement base course and base course, respectively.

**352.13 Construction Joints.** At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a vertical face. Damage to completed work shall be avoided. The base course shall be constructed and finished full width each day without longitudinal joints.

**352.14 Opening to Traffic.** The road shall be opened to traffic according to Article 701.05(b)(2).

**352.15 Maintenance.** The Contractor shall maintain, at his/her own expense, the entire base course in a manner satisfactory to the Engineer until the surface course has been constructed. Maintenance shall include immediate repairs of any defective or damaged portions of the base course. Repairs or replacements shall be made in such a manner as to ensure restoration of a uniform surface and durability of the portion repaired or replaced.

The Contractor shall also remove and replace, at his/her own expense, any soil-cement base course which is unsatisfactory due to its being placed over excessively wet or otherwise unstable subgrade; damaged by rain, freezing or other climatic conditions; damaged by traffic; or which is unsatisfactory due to failure to comply with any of the requirements specified.

**352.16 Tolerance in Thickness.** Soil-cement base course shall be constructed to the thickness shown on the plans. Determination of base thickness will be based on thickness measurements at cored points taken at locations selected by the Engineer. Any portion of the soil-cement base course that is less than 90 percent of the specified thickness shall be removed and replaced with new material to the correct thickness by the Contractor at his/her own expense.

**352.17 Method of Measurement.**

- (a) Contract Quantities. The requirements for the use of Contract Quantities shall conform to Article 202.07(a).
- (b) Measure Quantities. The work shall be measured for payment according to the following methods:
  - (1) Processing of soil-cement base course will be measured for payment in place and the area computed in square meters (square yards) of soil-cement base course completed and accepted.
  - (2) Cement incorporated in the soil-cement mixture will be measured for payment in kilograms (hundredweights), but payment will not be made for cement in excess of 105 percent of the amount specified by the Engineer.

- (3) Removal and disposal of unstable or unsuitable subsoil will be measured for payment as Removal and Disposal of Unsuitable Material according to Article 202.07(b).
- (4) Replacement of unstable or unsuitable subsoil will be measured for payment as Borrow Excavation or Furnished Excavation according to Article 204.07(b).
- (5) Cement treatment of unstable subsoil, if required by the Engineer, will be measured for payment according to (1) and (2) above.
- (6) Water used for mixing, compacting and finishing will not be measured for payment, but shall be considered as included in the cost of Processing Soil-Cement Base Course.
- (7) Any materials used or required for protection and cover will not be measured for payment but shall be considered as included in the cost of Processing Soil-Cement Base Course.

**352.18 Basis of Payment.** This work will be paid for at the contract unit prices as follows:

- (a) Per square meter (square yard) for PROCESSING SOIL-CEMENT BASE COURSE.
- (b) Per kilogram (hundredweight) for CEMENT
- (c) Per cubic meter (cubic yard) for REMOVAL and DISPOSAL of UNSUITABLE MATERIAL for the removal and disposal of unstable or unsuitable subsoil.
- (d) Per cubic meter (cubic yard) for BORROW EXCAVATION or FURNISHED EXCAVATION for the replacement of unstable or unsuitable subsoil.
- (e) Cement treatment of unstable subgrade soil, when specified by the Engineer, will be paid for at the contract unit prices for (a) and (b) above.

## **SECTION 353. PORTLAND CEMENT CONCRETE BASE COURSE**

**353.01 Description.** This work shall consist of constructing a portland cement concrete base with or without reinforcement as specified.

**353.02 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 – Material

Item	Article/Section
(a) Portland Cement Concrete .....	1020
(b) Reinforcement Bars .....	1006.10
(c) Longitudinal Metal Joints, Pins, Bar Supports .....	1006.11

**353.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Forms .....	1103.05
(b) Formless Paver .....	1103.16
(c) Form Grader .....	1103.06
(d) Water Supply Equipment .....	1103.11
(e) Batching and Weighing Equipment.....	1103.02-1103.03
(f) Concrete Mixers .....	1103.01
(g) Truck Agitator .....	1103.01
(h) Nonagitator Truck .....	1103.01
(i) Heavy Subgrade Template .....	1103.10
(j) Subgrade Planer .....	1103.08
(k) Subgrade Machine .....	1103.09
(l) Finishing Machine .....	1103.13
(m) Mechanical Longitudinal Float or Concrete Finisher Float ...	1103.14-1103.15
(n) Vibrator .....	1103.12, 1103.17
(o) Miscellaneous Equipment .....	1103.17
(p) Membrane Curing Equipment .....	1101.09

**CONSTRUCTION REQUIREMENTS**

**353.04 General.** The use of slip form paving will be permitted at the option of the Contractor. If the Contractor cannot obtain satisfactory results without the use of forms, the Department reserves the right to require the use of forms without additional compensation to the Contractor.

These items of work shall meet the following requirements:

Item	Article/Section
(a) Preparation of Subgrade or Subbase .....	420.05
(b) Joints .....	420.10
(c) Removing Forms .....	420.13
(d) Protection of Pavement .....	420.15
(e) Concrete Pavement-Slip Form Method .....	420.17
(f) Temperature Control for Placement .....	1020.14
(g) Tolerance in Thickness .....	420.18
(h) Bridge Approach Pavement .....	420.19
(i) Opening to Traffic (Note 1) .....	701.05(c)(6)

Note 1. The references in Article 701.05(c)(6) to portland cement concrete pavement shall be construed to include portland cement concrete base course.

**353.05 Forms and Form Setting.** Forms and form setting shall conform to the requirements of Article 420.06, except that the use of mechanical form tamper will not be required.

**353.06 Placing Concrete.** Placing concrete shall conform to the requirements of Article 420.07, except that a mechanical concrete spreader will not be required. When the base course is to be struck off and consolidated by either the vibrating screed method or the hand method, the concrete adjacent to both side forms shall be compacted with a vibrator inserted into the concrete and worked along the entire length of the forms before the finishing operations are started.

Truck mixers or trucks will be permitted on the finished subgrade or subbase when permitted by the Engineer. Approval will be withdrawn if rutting develops in the subgrade or subbase which would reduce the plan thickness of the base course.

**353.07 Transverse Construction Joints.** Transverse construction joints shall be constructed according to Article 420.10(g) except that No. 20 (No. 6) tie bars 900 mm (36 in.) long shall be centered across the joint on 375 mm (15 in.) spacings.

**353.08 Adjacent to Railroad Grade Crossing.** Portland cement concrete base course adjacent to railroad grade crossing shall be constructed according to Article 420.20 except that when the main line portland cement concrete base course thickness is greater than 225 mm (9 in.), the thickness of the portland cement concrete base course adjacent to the railroad grade crossing shall be constructed to the same thickness as the main line.

**353.09 Adjacent to Bridge Approach Pavement or Existing Pavement.** The bituminous plug adjacent to bridge approach pavement or existing pavement shall be constructed of bituminous concrete binder course mixture according to the applicable requirements of Section 406. At the Contractor's option, Class I bituminous concrete surface mixture may be used in lieu of the binder course mixture.

**353.10 Final Strike Off, Consolidation and Finishing.** The concrete shall be struck off, consolidated and finished according to Article 420.11, except the straightedging specified under Article 420.11 (c) shall be performed until the entire surface does not vary more than 5 mm (3/16 in.) from the straightedge and the final finish shall be according to Article 420.11 (e), Type B.

**353.11 Surface Test.** The finished surface of the base course shall be within the tolerance of the following surface trueness test:

The base course will be tested for trueness in each wheel lane at the expiration of the required curing or protection period. The surface will be tested by means of a 5 m (160 ft) straightedge placed parallel to the centerline of the base course, parallel to the grade line and touching the surface. Surface variations which exceeds 10 mm (3/8 in.) will be marked and shall be removed by an approved grinding device consisting of multiple saws. The use of a bushhammer or other impact devices will not be permitted. Determination of base course thickness will be made after the removal of high spots.

**353.12 Method of Measurement.**

- (a) Contract Quantities. The requirements for the use of contract quantities shall conform to Article 202.07(a).

Art. 354.01 Portland Cement Concrete Base Course Widening

- (b) Measured Quantities. Portland cement concrete base course will be measured in place and the area computed in square meters (square yards). The width shall be as shown on the plans or as directed by the Engineer.

Reinforcement bars will be measured in kilograms (pounds) according to Article 508.07. Tie bars will be measured according to Article 508.07.

**353.13 Basis of Payment.** This work will be paid for at the contract unit prices per square meter (square yard) for PORTLAND CEMENT CONCRETE BASE COURSE and HIGH-EARLY STRENGTH PORTLAND CEMENT CONCRETE BASE COURSE, of the thickness specified.

Reinforcement bars in special concrete slabs will be paid for according to Section 508.

The unit prices bid for the various items of PC concrete base course shall include any added thickness of base course adjacent to railroad grade crossings.

The bituminous plug at railroad grade crossing, bridge approach pavement or existing pavement will be paid for in metric tons (ton) as BITUMINOUS CONCRETE BINDER COURSE, CLASS I, TYPE 2, according to Section 406.

**SECTION 354. PORTLAND CEMENT CONCRETE BASE COURSE WIDENING**

**354.01 Description.** This work shall consist of widening existing pavement with a portland cement concrete base course widening not exceeding 1.8 m (6 ft) in width.

**354.02 Materials.** Materials shall meet the requirements of the following Article of Section 1000 - Materials:

Item	Article/Section
(a) Portland Cement Concrete .....	1020

**354.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Forms .....	1103.05
(b) Water Supply Equipment .....	1103.11
(c) Batching and Weighing Equipment .....	1103.02-1103.03
(d) Concrete Mixers .....	1103.01
(e) Truck Agitator .....	1103.01
(f) Nonagitator Truck (Note 1) .....	1103.01
(g) Finishing Machine .....	1103.13
(h) Vibrator .....	1103.12, 1103.17
(i) Miscellaneous Equipment .....	1103.17
(j) Membrane Curing Equipment .....	1101.09(c)

Note 1. The requirement for special bodies for nonagitating trucks shall not apply.



### CONSTRUCTION REQUIREMENTS

**354.04 General.** The methods used in performing the following items of work shall meet the requirements shown in the Articles listed below. The use of slip form methods for base course widening will be permitted at the option of the Contractor.

Item	Article/Section
(a) Removing Forms .....	420.13
(b) Temperature Control for Placement .....	1020.14
(c) Opening and Keeping Road Open to Traffic (Note 1) .....	701.05(c)(6)

Note 1. The reference in Article 701.05(c)(6) to portland cement concrete pavement shall be construed to include base course widening.

**354.05 Subgrade.** The subgrade shall be prepared according to Article 420.05 except as follows:

- (a) The subgrade excavation shall be to the required depth for at least the full width of the proposed base course widening prior to placing the concrete. Excavation of the subgrade shall be as specified in Article 202.06.
- (b) The subgrade shall be rolled with a roller of a type approved by the Engineer. It shall be not less than 300 mm (12 in.) in width and shall weigh from 9 N/mm (50 lb/in.) to 18 N/mm (100 lb/in.) of width of the roller.
- (c) Truck mixers or trucks will be permitted on the finished subgrade when approved by the Engineer. Approval will be withdrawn if rutting develops in the subgrade or subbase which reduces the plan thickness of the base course.

**354.06 Constructing Without Forms.** If the base course widening is constructed without forms, the following requirements shall apply:

- (a) The concrete shall be placed on the subgrade in a manner which will not cause segregation and which will meet the approval of the Engineer. It shall be struck off to the required elevation and properly consolidated. Consolidation shall be obtained by the use of internal vibration and by a mechanical surface vibrator or tamper, or one or more oscillating screeds. After the concrete has been consolidated, the surface of the concrete shall be finished by means of a metal plate. The plate shall be the full width of the widening and shall have a length of not less than 1 m (3 ft). The plate shall exert sufficient pressure on the concrete to produce a smooth and even surface.
- (b) The outer edge of the base course widening shall be supported for its full depth during the placing, consolidating and finishing of the concrete by a vertical slip form and thereafter by earth banked against the edge, except that if the consistency and consolidation of the concrete and the equipment

and method used are such that the concrete will retain its form satisfactorily, the earth support may be omitted.

- (c) The device used to construct the base course widening shall be guided by the edge of the existing pavement, and it shall ride exclusively on the existing pavement.

**354.07 Constructing With Forms.** If the base course widening is constructed with forms, the following requirements shall apply:

- (a) **Forms and Form Setting.** Forms and form setting shall conform to the requirements of Article 420.06, except a mechanical form tamper will not be required.
- (b) **Placing Concrete.** Concrete shall be placed according to Article 420.07, except that a mechanical concrete spreader will not be required. Spreading with shovels will be permitted. The base course widening may be struck off and consolidated by any of the three methods listed in Article 420.11 (a). The concrete adjacent to the side form and the existing pavement shall be compacted with a vibrator inserted into the concrete and worked along the entire length of the side form and the existing pavement before the finishing operations are started.
- (c) **Final Strike Off and Finishing.** The concrete shall be finished to an even and uniform surface by the use of hand floats or other approved methods.

**354.08 Curing and Protection.** The base course widening shall be cured and protected according to the applicable paragraphs of Article 1020.13. The total amount of membrane curing compound may be applied in one application of 1 L/3 sq m (1 gal/125 sq ft) instead of two applications, providing satisfactory coverage is obtained.

**354.09 Tolerance in Thickness.** The concrete base course widening shall be constructed to the thickness shown on the plans. Determination of concrete base course thickness and requirements relative to deficient thickness shall be as provided in Article 407.10, except as follows:

- (a) The width of a unit shall be the width of the concrete base course widening along one edge of the existing pavement.
- (b) Edge thickness may be measured instead of measuring the thickness at cored points. If edge thickness measurements are used, it shall be understood that references to cores and thickness at cored points will be applicable; and that the thickness of a unit will be determined in the same manner as would be done if the thickness had been measured at core points.

**354.10 Backfill at Edge.** Within 24 hours after completion of the base course widening, the remaining portion of the widening trench shall be back filled as specified in Article 202.06. Prior to opening the base course widening to traffic, the Contractor shall compact the earth backfill adjacent to the base course. Compaction shall be obtained with a pneumatic-tired roller, to the satisfaction of the Engineer.

**354.11 Earth Shoulders.** At locations where no provisions have been made for the repair or improvement of the earth shoulders, they shall be left in as good a condition as they were before work was started. Such work as the Contractor may have to perform to meet this requirement shall be done at no extra cost to the Department.

**354.12 Method of Measurement.** Portland cement concrete base course widening will be measured for payment according to Article 353.12.

**354.13 Basis of Payment.** Where the Department requires that portland cement concrete be used, this work will be paid for at the contract unit price per square meter (square yard) for PORTLAND CEMENT CONCRETE BASE COURSE WIDENING and HIGH-EARLY-STRENGTH PORTLAND CEMENT CONCRETE BASE COURSE WIDENING, each of the thickness specified.

When the Contractor has the option of using either Portland Cement Concrete or bituminous concrete according to Section 356, the work will be paid for at the contract unit price per square meter (square yard) for BASE COURSE WIDENING, of the thickness specified.

## SECTION 355. BITUMINOUS BASE COURSE

**355.01 Description.** This item shall consist of constructing bituminous base course on a prepared subgrade.

**355.02 Materials.** Materials shall meet the requirements of the following Articles of Section 1000 - Materials:

Item	Article/Section
(a) Coarse Aggregate (Note 1) .....	1004.01
(b) Fine Aggregate (Note 1) .....	1003.01
(c) Mineral Filler (Note 1) .....	1011
(d) RAP Material .....	1004.07
(e) Bituminous Material (Note 2) .....	1009.01-1009.05

Note 1. The coarse aggregate shall be crushed stone or crushed gravel CA-6 or CA-10. After processing through the plant, the aggregate(s) shall contain at least three percent minus 75  $\mu$ m (No. 200) sieve material as determined by an unwashed sample of the combined hot bin proportions. When approved by the Engineer, crushed gravel or crushed stone, as described in Article 1004.01 (a), may be blended with not more than 50 percent fine aggregate (passing the 4.75 mm (No. 4) sieve), as described in Article 1003.03 (a), and/or mineral filler to meet the CA-6 or CA-10 gradation. The percent of fine aggregate in the blend will be based on the cold feed proportions. Blending proportions shall not be changed during the progress of the work without permission from the Engineer. The coarse aggregate shall be Class C quality or better. When used, fine aggregate shall be Class C quality or better.

Note 2. The bituminous material used for this work shall be one of the following grades of asphalt cements: PG58-22 or PG64-22. When the pavement has a structural number (Dt) of 3.00 or less, PG52-28, PG58-28 or PG58-22 shall be used. When RAP material is used, PG46-28, PG52-28, PG58-28 or PG58-22 shall be used. The Engineer reserves the right to specify the grade which shall be used. The bituminous material shall not be changed during the progress of the work without permission from the Engineer.

**355.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Self-Propelled Pneumatic-Tired Roller (Note 1) .....	1101.01
(b) Three-Wheel Roller (Note 2) .....	1101.01
(c) Vibratory Roller .....	1101.01
(d) Tandem Roller (Note 3) .....	1101.01
(e) Hot-Mix Plant (Note 4) .....	1102.01
(f) Spreading and Finishing Machine (Note 5) .....	1102.03
(g) Pressure Distributor .....	1102.05
(h) Heating Equipment .....	1102.07
(i) Trench Roller .....	1101.01
(j) Hot-Mix Surge Bins .....	1102.01

Note 1. The self-propelled pneumatic-tired roller shall develop a compression of not less than 53 N/mm (300 lb/in.) nor more than 88 N/mm (500 lb/in.) of width of tire tread in contact with the bituminous surface. The tires shall be inflated to an air pressure of not less than 550 kPa (80 psi).

Note 2. The three-wheel roller shall have a mass (weight) of 5.5 to 9 metric tons (6 to 10 ton) and shall have a unit compression on the drive wheels of not less than 53 N/mm (300 lb/in.) nor more than 70 N/mm (400 lb/in.) of roller width.

Note 3. The tandem roller shall have a mass (weight) of 7 to 11 metric tons (8 to 12 ton) and shall have a unit compression on the drive wheels of not less than 45 N/mm (250 lb/in.) nor more than 70 N/mm (400 lb/in.) of roller width.

Note 4. A hot-mix plant conforming to Article 1102.01 will be require except that Articles 1102.01 (a)(5), (8), and (9), 1102.01 (b)(2) and (7), 1102.01 (c)(1) and (5), and the requirements of a metering system for the collected dust will not apply. When aggregates are blended, aggregate feeders for each size shall be provided according to Article 1102.01 (a)(5). If mineral filler is used, Article 1102.01 (b)(2) shall also apply. When a drier-drum hot-mix plant is used to produce bituminous base course incorporating RAP material, the plant shall be suitably modified to produce recycled bituminous mixes in a manner approved by the Engineer.

Note 5. In addition to the requirements of Article 1102.03, the screed of the spreading and finishing machine shall be supported. The supporting device shall have points of bearing not less than 4.5 meters (15 ft) apart. The

screed shall be adjustable and located midway between the bearing points. The back bearing points shall be smooth, steel wheels not less than 500 mm (20 in.) wide having a diameter of not less than 750 mm (30 in.) and shall ride on the surface of the mixture being placed. A suitable means shall be provided to lock the adjustment screws in place. The leveling device shall be effective in leveling depressions in the subgrade, subbase or the existing pavement, the leveling course and the binder course. The leveling device shall meet the approval of the Engineer and shall be used for all courses being placed. An automatic grade control device meeting the approval of the Engineer may be used in lieu of above leveling device.

## CONSTRUCTION REQUIREMENTS

**355.04 General.** The bituminous base course mixture shall be constructed on a dry, unfrozen subgrade prepared according to the requirements of Section 301 except Articles 301.04 and 301.05 will not apply, or Section 302 when specified.

**355.05 Composition of the Mixture.** The aggregate and bitumen proportioned within the following approximate composition limits by weight:

<u>Ingredient</u>	<u>Percent by Dry Weight</u>
Aggregate (CA-6 or 10).....	93.0 to 96.0
Asphalt Cement .....	4.0 to 7.0

When RAP materials are being used, the RAP material, virgin aggregate(s) and asphalt cement shall be proportioned within the following composition limits by mass (weight):

<u>Ingredient</u>	<u>Percent by Dry Weight</u>
Virgin Aggregate(s) .....	46-93
RAP Material(s).....	0-50
Mineral Filler (if required) .....	0- 5
Asphalt Cement .....	4.0-7.0

When required by the Engineer, the Contractor shall submit a sample of the aggregate(s) and asphalt, at least four weeks prior to the start of production, to the Central Laboratory in Springfield for mix design purposes. The percentage of bitumen will be set by the Engineer. The asphalt content and the aggregate gradation requirement will be verified by the extraction of the final mixture. The asphalt content shall not vary more than  $\pm 0.5$  percent from the bitumen content set by the Engineer.

Bituminous Concrete Binder Course Mixture A or B meeting the requirements specified in Article 406.13 will also be permitted.

**355.06 Preparation.** The asphalt cement shall be transferred to the asphalt tanks and heated to a temperature of 120 °C (250 °F) to 175 °C (350 °F). If the loading temperature exceeds 175 °C (350 °F), the asphalt shall not be used until it has cooled to 175 °C (350 °F). Wide variations in temperature which affect the amount of asphalt delivered will not be permitted.

When a hot-mix plant conforming to Article 1102.01 is used, the aggregate shall be dried and heated in the revolving drier to a temperature of 120 °C (250 °F) to 175 °C (350 °F).

The aggregate and bituminous material used shall be measured separately and accurately by weight or by volume. When the aggregate is in the mixer, the bituminous material shall be added and mixing continued until a homogeneous mixture is produced in which all particles of the aggregate are coated. The mixing period, size of the batch, or the production rate of continuous mixers will be established by the Engineer. A minimum of 30 seconds mixing time will be required for all types of plants.

The ingredients shall be heated and combined in such a manner as to produce a mixture which when discharged from the mixer will, in general, vary not more than 10 °C (20 °F) from the production temperature set by the Engineer. The temperature of the mixture shall not be more than 175 °C (350 °F). The mixture shall be delivered at a temperature of 110 °C (225 °F) to 175 °C (350 °F).

When RAP material(s) is used in the bituminous base course, the virgin aggregate(s) shall be dried and heated in the drier to a temperature that will produce the specified resultant mix temperature when combined with the RAP material.

The heated virgin aggregates and mineral filler shall be combined with the RAP material in such a manner as to produce a bituminous mixture which when discharged from the mixer shall not vary more than 15 °C (30 °F) from the temperature set by the Engineer. The combined ingredients shall be mixed for a minimum of 30 seconds or until a homogeneous mixture as to composition and temperature is obtained. For a batch type plant, the standard 15 seconds dry and 30 seconds wet mixing time should normally be used. Variation in wet and dry mixing times may be permitted, depending on the moisture content and amount of salvaged material used. The mix temperature shall not exceed 175 °C (350 °F). Wide variations in the mixture temperature will be cause for rejection of the mix.

The final mixture(s) shall conform to the following Standard Deviations. These deviations will be verified by extraction tests of the final mixture. If these stipulations are not met, the amount of RAP material used shall be reduced by ten percent increments per day until mix is produced meeting these requirements. When the Contractor is able to produce mixtures within these criteria for three consecutive days, the percent of RAP material may again be increased.

Selected Criteria (CA-6)	Standard Deviation 1/	Tolerance 2/
Passing 25 mm (1 in.) sieve	5.0	90-100
Passing 12.5 mm (1/2 in.) sieve	6.5	60- 90
Passing 4.75 mm (No. 4) sieve	5.5	30- 56
Passing 1.18 mm (No. 16) sieve	4.5	10- 40
Passing 75 µm (No. 200) sieve	2.5	4- 12
Bitumen	0.5	3- 7
Selected Criteria (CA-10)	Standard Deviation 1/	Tolerance 2/

Passing 25 mm (1 in.) sieve		100
Passing 12.5 mm (1/2 in.) sieve	6.5	65- 95
Passing 4.75 mm (No. 4) sieve	6.0	40- 60
Passing 1.18 mm (No. 16) sieve	5.0	15- 45
Passing 75 µm (No. 200) sieve	2.5	5- 13
Bitumen	0.5	3- 7

1/ - Represents the Standard Deviation of the overall population. 2/ - Individual tests shall be between these tolerances.

**355.07 Transportation.** Transportation of the mixture shall be according to Article 406.14.

**355.08 Placing.** The bituminous mixture shall be delivered at the required temperature and placed to the required grade with a spreading and finishing machine. The thickness of each lift shall not exceed a maximum of 100 mm (4 in.) thick when compacted, except the top lift shall be a nominal 50 mm (2 in.) thick compacted layer. If the Contractor elects to substitute an approved vibratory roller for one of the required rollers to compact the mix, the compacted lift thickness on the lower lifts may be increased to 150 mm (6 in.), provided the required density is obtained. The surface of each layer shall be clean and dry before succeeding layers are placed.

**355.09 Compaction.** Immediately after the bituminous mixture is placed, it shall be given an initial rolling with a three-wheel roller, pneumatic-tired roller, tandem roller or a vibratory roller. After the initial rolling, the base course shall be given a final or finish rolling with a tandem roller.

When initial rolling causes undue displacement, hair-cracking or checking in the base course, the time of rolling will be adjusted by the Engineer to correct these conditions.

The base course shall be compacted to a density of not less than 93 percent of the maximum theoretical density. The theoretical density will be determined by the high pressure air meter or according to ASTM D 2041.

The density of each of the finished lifts of bituminous mixture shall be obtained from nuclear test methods or from specimens furnished by the Contractor as provided in Article 406.16.

**355.10 Surface Test.** The finished surface of the base course shall be within the tolerance of the following surface trueness test. The completed base course will be tested for trueness in each wheel lane by means of a 5 m (16 ft) straightedge placed parallel to the centerline of the pavement, parallel to the grade line and touching the surface. Surface variations of the base measured from the base of the straightedge to the surface of the pavement shall not exceed 10 mm (3/8 in.). Areas which have variations exceeding 10 mm (3/8 in.) in 5 m (16 ft) shall be corrected as directed by the Engineer.

**355.11 Tolerance in Thickness** The base course shall be constructed to the thickness shown on the plans. Determination of the base course thickness will be based on thickness measurements, taken either at cored points or at the edge of the

base. Computation of thickness and penalties relative to deficient thickness shall be as provided in Article 407.10.

**355.12 Method of Measurement.** Bituminous base course will be measured for payment according to the requirements of Article 353.12. The reference in Article 353.12 to portland cement concrete base course shall be construed to include bituminous base course.

**355.13 Basis of Payment.** This work will be paid for at the contract unit price per square meter (square yard) for BITUMINOUS BASE COURSE, of the thickness specified.

## **SECTION 356. BITUMINOUS CONCRETE BASE COURSE WIDENING**

**356.01 Description.** This work shall consist of widening existing pavement with a base course consisting of bituminous concrete. The width of the base course is not to exceed 1.8 m (6 ft).

**356.02 Materials.** The materials for the bituminous concrete mixture shall meet the requirements specified in Article 406.02 or Article 355.02.

**356.03 Equipment.** Equipment used in the construction of this work shall meet the requirements of Article 406.03 or Article 355.03, except that a mechanical spreader meeting the approval of the Engineer shall be used to place the bituminous concrete mixture.

If the Contractor elects to use a vibratory roller for compacting concrete mixture, it shall meet the approval of the Engineer.

## **CONSTRUCTION REQUIREMENTS**

**356.04 Keeping Road Open to Traffic.** The road shall be kept open according to Article 701.04 (b) (1).

**356.05 Subgrade.** The subgrade shall be prepared according to Section 301 except Articles 301.04 and 301.05 will not apply. The following shall also apply:

The material adjacent to the edge of the existing pavement shall be excavated for the full bottom width required and to the required depth. The method used to excavate the subgrade shall be as specified in Article 202.06. After the excavation has been completed, the subgrade shall be compacted by rolling according to Article 354.05 (b).

**356.06 Base Course Widening.** The bituminous concrete mixture used to construct the base course widening shall be Binder Mixture A or B, meeting the requirements specified in Articles 406.10 and 406.12 and shall be transported according to Article 406.14, or it may be Bituminous Base Course Material meeting the requirements of Section 355.



After the subgrade has been compacted and is acceptable to the Engineer, the bituminous concrete mixture shall be spread upon it with a mechanical spreader.

Prior to placing the bituminous concrete mixture, the exposed edge of all existing pavement shall be cleaned of loose material to the satisfaction of the Engineer. This work shall be considered as included in the cost of Bituminous Concrete Base Course Widening.

Immediately after the mixture has been spread, it shall be rolled. Two rollers will be required. Rollers shall be operated at a speed of not more than 45 m (150 ft) per minute. If the Contractor elects to use a vibratory roller for compacting the bituminous concrete mixture, the initial rolling of each layer shall be made with a nonvibratory roller.

The bituminous concrete mixture shall be placed in two or more layers. The top or final layer shall not be less than 50 mm (2 in.) in compacted thickness.

Each layer of bituminous concrete mixture shall be compacted to a density of not less than 93 percent of the maximum possible density of a voidless mixture composed of the same materials in like proportions. If the required density cannot be obtained when the bituminous concrete mixture is spread and compacted in two layers, the mixture shall be spread and compacted so as to provide three equal, compacted layers. If the required density cannot be obtained when the bituminous concrete mixture is spread and compacted in three layers with two rollers, an additional roller will be required. No additional compensation will be allowed the Contractor should the Contractor be required to construct the widening in three layers or provide an additional roller.

Only one layer of bituminous concrete mixture shall be placed in a days run regardless of its thickness, unless otherwise authorized by the Engineer.

While compacting the top layer of the bituminous concrete mixture, care shall be exercised to keep the roller off the edge of the existing pavement so that the entire weight of the roller will be upon the mixture being compacted.

The density of each compacted layer will be obtained by approved nuclear methods or from specimens furnished by the Contractor. Specimens shall be cut by the Contractor from each compacted layer with a core drill. The diameter of a specimen shall be no less than 90 mm (3 5/8 in.). Two specimens shall be taken from each day's run not later than the morning of the first work day following the previous placement. When directed by the Engineer, additional specimens shall be taken but the total number from one day's run will not exceed ten. The Contractor shall remove the specimens at locations designated by and in the presence of the Engineer and transport them to the plant laboratory. Care shall be exercised to avoid damage to the specimens. The holes caused by the removal of the specimens shall be refilled immediately with a bituminous mixture meeting these specifications, compacted, and finished to the satisfaction of the Engineer. The cost of this work will not be paid for separately, but shall be included in the unit price bid per square meter (square yard) for Bituminous Concrete Base Course Widening.

**356.07 Tolerance in Thickness.** Determination of bituminous base course widening thickness and requirements relative to deficient thickness will be according to Article 354.09.

**356.08 Backfill at Edge of Widening.** Backfilling at edge of widening shall be performed as specified in Article 354.10.

**356.09 Earth Shoulders.** Earth shoulders shall be constructed according to Article 354.11.

**356.10 Method of Measurement.** Bituminous concrete base course widening will be measured for payment according to the requirements of Article 353.12. The reference in Article 353.12 to portland cement concrete base course shall be construed to include bituminous concrete base course widening.

**356.11 Basis of Payment.** Where the Department requires that Bituminous Concrete be used, this work will be paid for at the contract unit price per square meter (square yard) for BITUMINOUS CONCRETE BASE COURSE WIDENING, of the thickness specified.

When the Contractor has the option of using either portland cement concrete as outlined in Section 354 or bituminous concrete according to Section 356, the work will be paid for at the contract unit price per square meter (square yard) for BASE COURSE WIDENING, of the thickness specified.

**SECTION 357. POZZOLANIC STABILIZED BASE COURSE**

**357.01 Description.** This work shall consist of constructing Pozzolanic Stabilized Base Course.

**357.02 Materials.** Materials shall meet the requirements of Article 312.12 with the following addition:

Item	Article/Section
(a) Hot-Poured Joint Sealer .....	1050.02

**357.03 Equipment.** Equipment shall meet the requirements of Article 312.22 with the following addition:

- (a) Heating Equipment for Joint Sealant (Note 7)

Note 7. The heating equipment shall be of an indirect heating type with positive temperature control, mechanical agitation and recirculating pump.

**CONSTRUCTION REQUIREMENTS**

**357.04 General.** The requirements for constructing Pozzolanic Stabilized Base Course shall conform to Articles 312.23-312.28. References in these Articles to subbase and pozzolanic stabilized mixture shall be construed to include base course

and pozzolan stabilized base course, respectively. The subgrade shall be prepared according to Section 301 except Articles 301.04 and 301.05 will not apply.

In addition to the requirements of Article 312.28, transverse joints shall be constructed full plan width of the completed base course and sealed with hot-poured joint sealer. When base course is constructed adjacent to existing pavement, this joint will not be required. Joints shall be located at spacings of 9 m (30 ft) perpendicular to the centerline. Construction and sealing of the joints shall be performed as shown on the detail drawing included in the plans or as directed by the Engineer.

The base course portion of the joint shall be cut within 72 hours of base course compaction. This portion may be cut separately or in conjunction with the surface course portion if the 72 hour requirement can be met. The location of the joint in the surface portion shall not vary by more than 5 mm (3/16 in.) from the location of the joint in the base course.

Sealing of the surface course joints shall be performed according to Article 420.14(a), except that sealing shall commence immediately upon sawing of the joint.

The finished base course may be opened to local traffic 36 hours after the finishing operation unless otherwise directed by the Engineer and to all traffic after placement of surface course.

Contraction joints shall be established in all base removed and replaced over 9 m (30 ft) in length.

**357.05 Tolerance in Thickness.** Tolerance in pozzolan stabilized base course thickness shall be as specified in Article 352.16. The reference to soil-cement base course in Article 352.16 shall be construed as including pozzolan stabilized base course.

**357.06 Method of Measurement.**

- (a) Contract Quantities. The requirements for the use of contract quantities shall conform to Article 202.07(a).
- (b) Measured Quantities. Pozzolan stabilized base course of the thickness specified will be measured for payment in place and the area computed in square meters (square yards). The width for measurement will be the width of the top of the base course as shown on the plans or as directed by the Engineer. The liquid asphalt for the curing coat, any sand required, and the construction and sealing of contraction joints will not be measured for payment, but shall be considered as included in the contract unit price bid for Pozzolan Stabilized Base Course.

**357.07 Basis of Payment.** This work will be paid for at the unit price per square meter (square yard) for POZZOLANIC STABILIZED BASE COURSE, of the thickness specified.

**SECTION 358. REPAIR AND PREPARATION OF BASE COURSE**

**358.01 Description.** This work shall consist of the repair and preparation of existing surfaces, which are to be used as bases for the various types of surface courses.

**358.02 Materials.** Materials shall meet the requirements of the following Article of Section 1000 - Materials:

Item	Article/Section
(a) Aggregate .....	1004.04

**358.03 Equipment.** Equipment shall meet the requirements of the following Articles of Section 1100 - Equipment:

Item	Article/Section
(a) Pneumatic-Tired Roller .....	1101.01
(b) Mechanical Sweeper .....	1101.03

**CONSTRUCTION REQUIREMENTS**

**358.04 Aggregate Bases.**

- (a) General. All loose materials on the surface of the proposed base course which are of such size, gradation and quality that they can be utilized, shall be bladed to the shoulders and left in windrows together with any material already in windrows or stockpiles. All such materials shall be incorporated in the work or disposed of as directed by the Engineer. The repair and preparation of newly constructed bases shall not be undertaken until it has been opened to traffic for a period of not less than ten days.
- (b) Repairs. All failures (potholes, deep depressions or ruts) occurring in the existing surface to be used as the base, shall be repaired by scarifying, removing all foreign material and reshaping. If additional material is needed to bring the surface to the required cross section, CA-6 aggregate shall be used. The repaired areas shall then be compacted thoroughly by means of a pneumatic-tired roller or a hand tamper as directed by the Engineer. If the moisture content of the aggregate is such that compaction satisfactory to the Engineer cannot be obtained, water shall be added.
- (c) Preparation. After the repairs have been made in the base course, any area having ruts, depressions, corrugations, excessive crown or loose material, shall be brought to a smooth grade and proper crown by repeatedly wetting with water applied by means of a sprinkler, blading with a road grader or multiple blade maintainer, and rolling with a pneumatic-tired roller. The base course shall be bladed lightly to such a depth that sufficient material will be obtained to true up the surface of the base course. During the smoothing operations, the roadbed from the edges of the base to the shoulder lines shall be bladed to a smooth uniform slope so that the surface will drain and not impound water.

After the surface of the base course has been brought to a smooth grade and proper crown, it shall be compacted by repeated wetting and rolling with a pneumatic-tired roller for a period of not less than two days. During this time, the surface shall be kept in a damp condition. Before a prime coat is applied, the base shall be surface dry, but at no time shall the period of drying be less than 24 hours. When required by the Engineer, the base course shall be swept with a mechanical sweeper or hand brooms before a prime coat is applied. The sweeping shall be continued until all dust, mud and foreign material are removed. Traffic shall not be allowed upon the prepared base course after the final sprinkling, or, if a bituminous prime coat has been applied, until the Engineer has approved the penetration of the prime coat.

### **358.05 Old Bituminous, Brick and Concrete.**

- (a) Repair. All loose and defective material shall be removed from all holes, ruts or depressions in the existing surface. These areas shall then be filled as provided in the contract.
- (b) Preparation. After the base course has been patched and permitted to cure, it shall be cleaned by means of a mechanical sweeper, hand brooms, flushing with water, or by other approved methods. Special care shall be taken to clean the surface of the base course adjacent to the edges, so that the full width of the surface to be treated will be clean. The surface of the base course shall be clean and dry when the surface course is placed.

### **358.06 Method of Measurement.**

- (a) Contract Quantities. The requirement for use of contract quantities shall be according to Article 202.07(a).
- (b) Measured Quantities. The work in connection with the repair and preparation of bases, except materials, will be measured for payment in place and the area computed in square meters (square yard).

If additional material is required for the repair of aggregate bases, it will be measured for payment in metric tons (ton) according to the requirements of Article 311.08(b).

If additional material is required for the repair of old bituminous, brick, or concrete bases, it will be measured for payment as provided for in the contract.

**358.07 Basis of Payment.** The work in connection with the repair and preparation of bases, except materials, will be paid for at the contract unit price per square meter (square yard) for PREPARATION OF BASE.

Additional material required for the repair of aggregate bases, will be paid for at the contract unit price per metric ton (ton) for AGGREGATE BASE REPAIR.

When the contract does not contain a unit price for the material required for the repair of any type base, it will be paid for according to Article 109.04.

